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Vol. xx OCTOBER, 1915. No. 10

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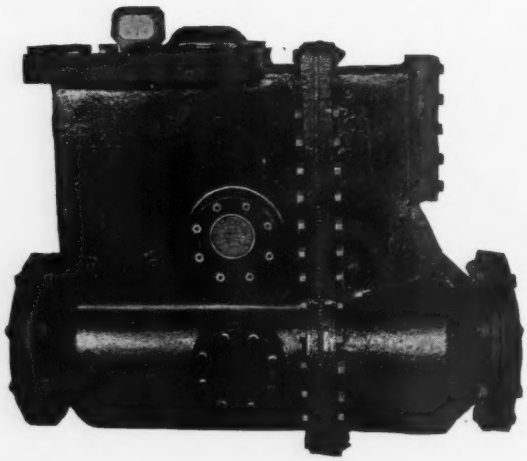

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COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC.

Vol. XX OCTOBER, 1915 No. 10

FIG. 1. LOADING AND STORAGE TRESTLE. TUNNEL ENTRANCE IN BACKGROUND.

THE LINING OF SANDY RIDGE TUNNEL

BY ORLANDO K. MORGAN.

The Carolina, Clinchfield and Ohio Railway has recently completed and placed in operation that portion of its line known as the Elkhorn Extension, thus extending the line from Dante, Va., to Elkhorn City, Ky., the terminus of the Big Sandy Division of the Chesapeake and Ohio Railway. Where the above extension passes under the divide known as "Sandy Ridge" just north of Dante, Va., there is a tunnel, single track, 7,804 ft. long. This tunnel passes for about one-half its length through slate and shale formations which disintegrate upon exposure to air, and the remaining half through sandstone formation badly seamed and broken. In view of these conditions, the management decided to promptly begin the lining of the entire tunnel with concrete.

This work would require the placing of between 50,000 and 60,000 cu. yds. of concrete, all of which would have to be done while traffic was passing through the tunnel.

In addition to Sandy Ridge there are a number of other tunnels on the above exten-

FIG. 2. TRESTLE FROM SOUTH PORTAL.

sion as well as on other portions of the road which may require lining in the future under similar conditions of traffic. With this in mind the Railway Company engineers made a special study of various plans for the above work by which it could be done with economy and rapidity, also holding in mind that much of the plant would be used for similar work after this particular job is finished.

The result of these studies was the determination to use the compressed air method of mixing and placing the concrete, and to provide for this a plant as follows:

(1) A self-propelled concreting car.

(2) A loading and storage trestle.

(3) Compressed air plant and pipe line through tunnel.

(4) Concrete forms quickly and easily movable.

These features will be described separately.

CONCRETE CAR.

On account of the great length of the tunnel it was deemed impracticable to furnish the concrete from a mixer located at either portal. It was concluded at the outset that the mixing could be done inside the tunnel where the concrete was to be deposited, and the conclusion was that a car carrying the ingredients would be the proper solution. It also appeared most desirable, if not absolutely necessary, to handle the car without filling the tunnel with smoke. These premises led to the idea of a concreting car self-propelled and finally to the gasoline engine as most nearly fulfilling all conditions for the propelling device. A gas engine would emit only a small amount of smoke or gas while moving and could be shut off entirely when position was taken. It occupies but small space and can be operated by one man, and, contrary to general belief, it is very reliable. To obtain capacity, gravity flow of materials, and a convenient and desirable arrangement, the car must be made as large as the standard clearance of the road would permit after allowing room for concrete forms. The dimensions are 40 ft. long over end sills, 10 ft. 4½ in. wide over braces, and 17 ft. 9 in. from top of rail to top of car. It was decided to build it of steel as the material bins are high above the rail and the weights considerable.

The principal features of the car are:—

A central chamber, open on the sides, 8½ ft. long, 9 ft. 8 in. wide, and 10 ft. 3 in. high,

in which is located on one side the concrete (pneumatic) mixer and on the other side the charging skip. Over this chamber is a water tank of 1850 gallons capacity. This tank furnishes water for the concrete and is also connected with the cooling system for the gasoline engine. Facing the central chamber is the stone bin (30 cu. yds. capacity) on one end and the sand bin (12 cu. yds. capacity) on the other. Each bin has a chute 20 in. wide leading to the charging skip, and each chute pipe at the bottom running horizontally and curving to the outside of the rear truck and thence vertically to near the top of the car, where it branches by means of a wye into two lines, one a 180-degree bend to the rear for "shooting" in foundation and sidewall, and the other going to the roof for "shooting" into the arch. The wye is a special patented device with a sliding plate controlling the movement of material into either arm. The arrangement of the pipe, traveling with the

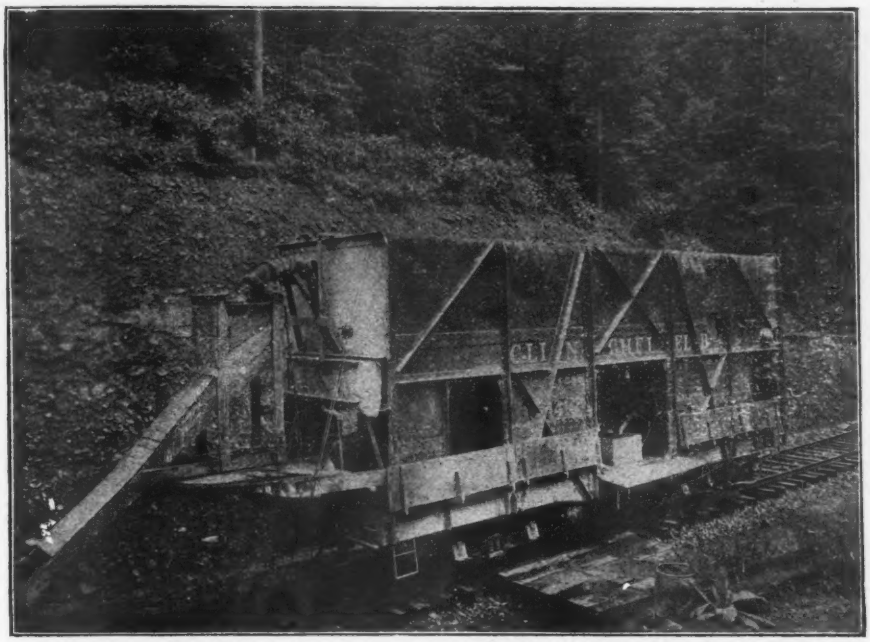

FIG. 3. CONCRETING CAR. CENTER OF SIDE PLATFORM IN WORKING POSITION.

is controlled by an under-cut gate. Under the stone bin is space occupied by a 96 cu. ft air receiver standing vertically, and also space for storage of cement in bags and protected from water by the bin overhead. Under the sand bin is the gasoline engine and its auxiliary equipment completely housed from water and dust. The charging skip in its lower position stands its top rim about 1 ft. 3 in. above the floor, and it travels on inclined guide rails (40 lb. Tee rails) to its upper position over the mixer, being hoisted by a compressed air cylinder 9¼ in. diameter. The gate of the skip works automatically by means of a guide rail. The mixer is for a two-bag batch (4-10 cu. yd.) and has its 8-in. outlet

car and being in position at all times for "shooting" concrete, is an important one in saving time and expense. One of the difficulties of many jobs where the pneumatic mixer has been used was the handling of the big heavy pipe.

Along one side of the car is a folding platform 2 ft. wide level with the main floor. This is used by the men carrying cement and to get to and from the engine room, during the ordinary work of the car this platform remains down.

The entire arrangement is compact and with a view of saving manual labor. One man controls the hoisting of skip, injection of water, and mixing and discharge of the batch.

One man is placed at each chute and two men carry, open, and empty the cement bags.

The gasoline engine is of the six-cylinder four-cycle Tee head type and rated 200 H. P. at 350 r. p. m. It can be throttled to 125 r. p. m. The motor and its frame constitute one of the trucks of the car. The cylinders stand in a row at right angles to the track and the whole construction is compact but accessible. It is started by compressed air being admitted to three cylinders, then the explosion of the gasoline takes place in the other cylinders and continues the motion. The transmission is by means of a Morse chain on to the driven axle (one only being used) and the control is through a friction clutch of special design. The general principle employed is much the same as in the ordinary automobile. The car and gasoline engine were built by the McKeen Motor Car Co., of Omaha, Nebraska. It was sent knocked down and was erected at the Railway Shops at Erwin, Tenn., and moved to the work (105 miles) under its own power at a speed ranging at times as high as 25 miles per hour. The mixer was installed and the piping done on the car by the Pneumatic Placing Company of 45 Broadway, New York City.

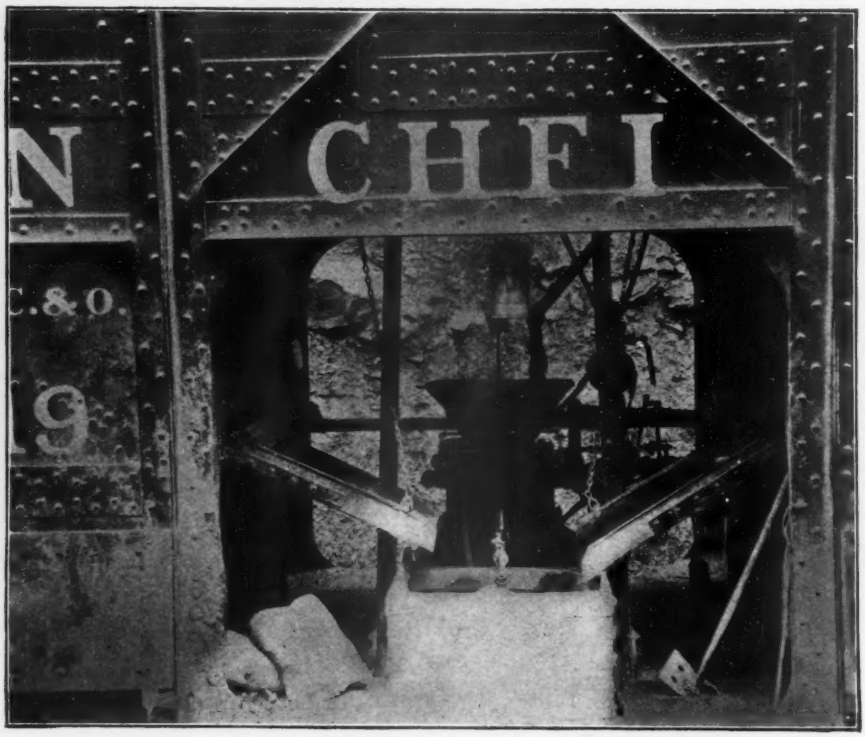

FIG. 4. WORKING CHAMBER OF CAR.

LOADING AND STORAGE TRESTLE.

This is of special design and so arranged that the above car goes under it and receives stone (crusher run), sand, cement (in bags), and water, all by gravity and frequently all at the same time. The sand and stone is drawn from overhead bins by means of under cut gates. Cement is conveyed into car by a chute. The trestle has a track over its deck upon which stone and sand in hopper cars is stored or unloaded into the bins below. There is a continuous row of 27 bins with an aggregate capacity of 324 cu. yds. and total length of 162 ft., and five loaded cars can be stored over these bins, giving a storage of 200 cu. yds. in addition to the above. The trestle is built of timber and attention is called to the unusual arrangement of posts and bracing.

COMPRESSOR PLANT AND PIPE LINE.

The compressor plant is exceptional for a

temporary outfit. To save money on foundations and at the same time increase the space, the floor level of boilers and compressors was fixed 4½ ft. above sub-grade and the concrete foundations and rim walls were built up to this height and the space underneath utilized for water tanks and ash pit. The building is of 1 in. boards covered with tar paper. The arrangement chosen permits coal to be dumped from cars on trestle above described to a pile in front of the boilers. There are two boilers, both locomotive type, one new 150 H. P., one old 70 H. P. They are so connected by piping that either one can be cut in or out of service for cleaning or repairs. Two compressors are installed but an extra foundation for another unit is provided, the reason for which appears elsewhere. The compressors are alike and of the Ingersoll-Rand R. R. I. Rogler Valve class. This is a high speed, single stage, modern type compressor. Steam cylinder 12x12, air cylinder 12x14, piston displacement, at 250 r. p. m., 528 cu. ft. and actual output about 375 cu. ft. of free air per minute each, or 750 cu. ft. for both. They work under 125 lbs. steam pressure and compress air to 115 lbs. They are cooled by water brought by gravity from an old coal mine mouth. From the compressors a 6-inch pipe leads to a 150 cu. ft. air receiver and thence a 4-inch pipe line goes on a steady 0.5 per cent down grade entirely through the tunnel At the lower end is a pet cock to draw off any water. In order to care for expansion and contraction the pipe line is laid alternately on the east and west sides of the track in lengths of about 1,000 ft. connected by curves of 2 ft. radius. The bottom of the pipe is at level of bottom of ties and distant 1 ft. 0 in. from end of ties. About every 100 ft. a long radius tee is placed and about 20 mine cocks of 4-inch size are provided; these can be shifted to the various tees as the progress of the work demands. From the mine cock a 3-inch hose connects with the 96 cu. ft. air receiver on the car. The arrangement thus being that by means of a hose 60 ft. long the car can be connected to the 4-inch pipe line at any point at which it may stop and receive an ample supply of air.

FIG. 5. FLASHLIGHT OF CONCRETE WORK IN TUNNEL.

FORMS.

The forms are of steel except the arch ring, which is 3-inch hard pine on steel ribs. They are of the Blaw collapsible type but of exceptionally stiff design. They are held by anchor bolts to the walls of the tunnel and

are without interior bracing, rods or struts, so that the concreting car as well as trains may pass without interruption. They are collapsible by inserting temporary rods, which are removed after this is done. Five 30-ft. sections are provided, and it is expected the car will fill at least one section each day and lose no time waiting for the moving of forms or for concrete to take its set. For the foundations and initial bench wall, wooden forms are in use. They are made in sections of 12 ft. and braced from the track and are taken down and carried ahead and re-used as required.

one run of 201 cu. yds. have been made. The work so far has been putting in the foundation and initial lift of bench wall 4 ft. 4 in. high, which requires moving the car more than will be necessary when "shooting" into the arch form. The performance is, however, largely dependent upon interference from trains passing through the tunnel.

Another feature of this plant is the short pipe through which the charge moves. Generally speaking, it has been held that at least 50 ft. of pipe was necessary to get a good mixture of concrete. In this case it goes through

FIG. 6. LOOKING OUT OF SOUTH END OF TUNNEL.

IN GENERAL.

The car began regular operation in the tunnel on July 9, 1915, and has worked every day since, Sundays excepted, and has steadily increased its output as the men have become more used to the work and better organized, as shown by the following record:

Week ended July 17, 1915, 261 cu. yds.
Week ended July 24, 1915, 379 cu. yds.
Week ended July 31, 1915, 516 cu. yds.
Week ended Aug. 7, 1915, 822 cu. yds.
Week ended Aug. 14, 1915, 928 cu. yds.

Several runs of 180 cu. yds. per day and 41 ft. of pipe and 10 ft. of chute and the mixture is good. In several installations concrete has been placed through 1,200 ft. of pipe, and the record for distance to date is 2,805 ft.

One of the difficult problems confronting the designer is to place the charges of ingredients into the mixer fast enough to work it to its capacity. The mixer can shoot a batch every 15 seconds provided sufficient air is furnished. But to give it a charge of material every 15 seconds seems to be an unsolved problem.

Time records of the device here used show the speed at which batches are discharged,

giving the actual time the car is coupled to the hose and working inside the tunnel.

Aug. 17, 1915, 423 batches in 381 minutes, average 54.0 seconds per batch.

Aug. 18, 1915, 323 batches in 302 minutes, average 56.1 seconds per batch.

Aug. 19, 1915, 448 batches in 340 minutes, average 45.5 seconds per batch.

Aug. 20, 1915, 325 batches in 250 minutes, average 46.1 seconds per batch.

Aug. 21, 1915, 309 batches in 280 minutes, average 54.3 seconds per batch.

The variation is due to condition of material, whether wet or dry, which affects the rapidity with which it flows in chutes and skip. It is believed the operation can be speeded up to an average of about 35 to 40 seconds with dry material. Observe that the door of the skip automatically opens as the skip reaches to position and closes as it is lowered away from same, also the door serves as a chute while open, also that side slopes are steep and unbroken, so that it can free itself quickly. The material when damp has a decided tendency to arch either vertically or horizontally and frequently this arch must be broken by hand. The hoisting of the skip, the placing of the water, and the discharge of the batch is all controlled by one operator.

The lighting of the inside of the car is by carbide lights and of the outside work by hand torches and carbide lights.

A great diversity of opinion exists among those familiar with the compressed air method of mixing and placing concrete as to the quantities of air required. So far it appears that the present plant with a capacity of 750 cu. ft. of free air per minute is ample for this work, but on account of this difference of opinion provision has been made in the compressor house for the placing of an extra compressor in case it is required. It was found that one compressor alone slowed the work down to a batch in about 1¼ minutes.

The plant was designed by O. K. Morgan, office Engineer, under the general direction of Ward Crosby, Chief Engineer, of the C. C. & O. Ry.

The pressure of the atmosphere in pounds per square inch at any altitude may be closely approximated for ordinary temperatures by multiplying the height of the mercury barometer in inches by 0.491.

INSTALLING AIR LIFT PUMPS

BY A. H. FORD.*

The increasing use of deep wells as sources of water supply for cities in different parts of the country has greatly stimulated the adoption of the air lift. Briefly the advantages and disadvantages of air lifts may be reviewed as follows. They are superior to pumps of other kinds because of the entire lack of moving parts in the well and the large rate of flow which can be obtained by their use. These are especially desirable qualities when one or two wells are depended on to furnish the entire water supply of a town. Opposed to these desirable qualities is the low efficiency of the device. Its use should therefore be limited to those cases where efficiency can be sacrificed for the sake of reduction in maintenance expense, increase in well output or increase in reliabilty.

In general an air lift consists of an air pipe extending a considerable distance below the level of the water in the well and so arranged that the air supplied to it by an air compressor, located at the surface of the ground, is delivered near the bottom of the eduction pipe which carries the mixture of air and water to the point of discharge.

The maximum air pressure required to start a lift to operating is equal to 2.31 times the submergence of the air pipe, in feet. As soon as the lift begins to operate, the pressure is reduced; because of the drawing down of the water in the well, thus reducing the submergence, and increasing the lift. This lowering of the water level may be considerable and is the determining factor in fixing the economical output of a well.

A number of the factors which enter into the efficiency of an air lift must of necessity be determined by experiment on the particular well in question; but some of them admit of generally applicable determinations being made. Among these is the best form of foot piece, as the connection between the air pipe and the eduction pipe is called. There are a number of forms of foot piece on the market, for some of which extravagant claims of efficiency are made; but as wide variations in the efficiency are due to slight changes in

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*Iowa City, Iowa. From paper before Iowa Engineering Society.

TABLE I.—EFFECT OF SUBMERGENCE ON EFFICIENCY OF AIR LIFT AT HATTIESBURG, MISS.

Submergence lift.	Efficiency. Per cent.
8.70	26.5
5.46	31.0
3.86	35.0
2.91	36.6
2.25	37.7
1.86	36.8
1.45	34.5
1.19	31.0
.96	26.5

Flow about 1,100 gals. per min.
Lift about 37 ft.

proportion of other parts of the system or the method of operation, such claims are to be looked on askance, unless they are backed up by adequate guarantees. Tests have shown that the effect of a change in foot piece may be to increase the efficiency as much as 50 per cent. when the head is high, with a much smaller increase when the head is low.

The efficiency of even a well designed air lift is low; varying from 20 per cent for a lift of 600 feet, to 45 per cent for a lift of 50 ft.; and is greatly influenced by the ratio of the submergence of the air pipe to the lift; the best ratio being about 2. This is clearly shown in Table I giving data on a test of a well at Hattiesburg, Miss., as reported in "Pumping by Compressed Air," by E. M. Ivins. In this test, the speed of the air compressor was adjusted so as to keep the rate of flow of water constant, while the length of the air pipe was varied. The dimensions of the well and air lift were as follows:

Total depth of well, ft.	453.5
Inside diameter of casing, ins.	9⅝
Inside diameter of air pipe, ins.	2½
Inside diameter eduction pipe, ins.	9⅝
Static lift, feet.	4.0

The results in Table I show that the maximum efficiency is secured when the submergence is 2.5 times the lift and that the efficiency falls off more rapidly for a reduction in the submergence than for an increase. It is a good plan therefore to have the submergence more than that calculated for the best efficiency, rather than less. This allows for the usual occurrence, viz., that the pumping lift increases as more wells are sunk and as the well is pumped more.

Previous to this test the length of the air

TABLE II.—RESULTS OF TESTS TO DETERMINE BEST FLOW FROM DEEP WELLS AT HATTIESBURG, MISS., WITH AIR LIFT.

Length of air pipe (feet).	Flow (gal. per min.).	Lift (feet).	Efficiency. Per cent.	Duty (gals. per hp.-hr.)
224	1,495	47.5	32.6	1,630
208	1,459	45.8	31.5	1,640
184	1,419	44.3	31.1	1,670
162	1,359	39.4	30.0	1,790
142	1,299	37.7	30.6	1,920
124	1,219	37.5	32.8	2,070
105	1,106	37.1	36.7	2,340
86	1,008	32.5	33.4	2,450
79	904	29.3	31.3	2,530
67	802	26.0	30.5	2,750
43	690	21.2	29.8	3,240

pipe in this well had been varied with a view to finding out the best flow at which to operate the well. The important data are given in Table II.

The air supply was apparently adjusted so as to get the best efficiency for each submergence.

This test shows an anomalous variation of the relation of lift to rate of flow; which is probably due to the coming into action of a second water bearing stratum, there being two cut by the well, when the level of the water had dropped 35 ft. on account of the operation of the lift.

The writer believes that pump duty, water pumped per unit of energy supply, should be made the criterion of operation rather than mechanical efficiency. He has therefore calculated the last column. This shows that the test was not carried to low enough submergence to reach maximum duty. The duty of this lift would have been increased 42 per cent, and the cost of pumping reduced that amount, had the well been operated at a flow of 700 gals. per minute instead of 1,100 gals. per minute. The demand for water might not have allowed operation at this rate in this case, but in general the rate of pumping should not be so high as to lower the water level in the well to such an extent as to seriously decrease the duty.

The Hudson Coal Co. has created the position of Safety Engineer. Mr. R. Y. Williams will fill the position and will devote all of his time to the prevention of accidents. His headquarters will be in Scranton.

THE AIR LIFT FOR COAL MINES

BY S. W. SYMONS.*

The air-lift pump has found its chief field in municipal and private water-supply, and there are many large coal mines using it for such purposes. It has not been used extensively for shaft unwatering and mine drainage, although it is better adapted to such work under certain conditions than any other method of pumping.

Of the many air-lift plants in operation, some are working at a better economy than would be possible with other methods of pumping. As the matter of cost of operation is one that can be determined only after knowing all the working conditions of a given case, economy is often by no means the governing consideration; sometimes reliability and simplicity are of even greater importance, and it is in such cases that the air-lift method excels.

For shaft unwatering, the ease and cheapness of installation, absence of moving parts under water, ability to handle acidulous and foul water and the high rate of discharge from a given size of pipe are obvious advantages peculiar to the air lift.

For mine-drainage work, the great simplicity of the system, the fact that any number of pumps can be operated from one compressor plant and the absence of complicated mechanism in restricted situations underground are its chief recommendations.

A special case of mine drainage where the air lift can be used to great advantage is when water is struck at a low level a long distance from the main pump or shaft—sometimes a matter of a mile or more. Instead of laying long and expensive pipe lines, it is often both cheaper and more satisfactory to install an air lift by putting in a bore-hole from the surface to pass through the workings at or near the low point. With a properly designed air-lift pump it is easy to see that the efficiency of such an arrangement would be considerably greater than the forcing of the water through several hundred feet of pipe to the shaft. Fig. I shows the arrangement clearly.

Just such a case was that of the Clinton Coal Co., of Clinton, Ind. In this instance water had broken into the mine about 4,000 ft. from the shaft at a spot 160 ft. from the

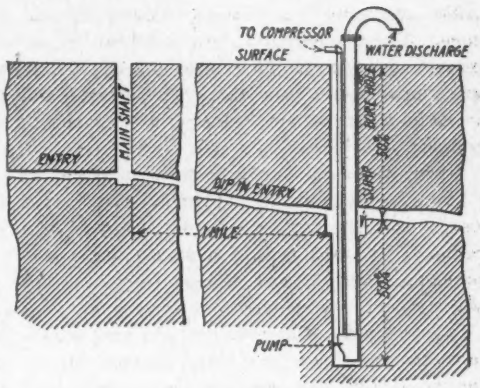


FIG. I. HOW MINE WORKINGS MAY BE DRAINED BY AIR LIFT.

surface. It was not until after two lines of 3-in. pipe had been laid and proved inadequate that resort was had to the air lift. The lift was kept in operation 24 hr. a day for four months before the water was sufficiently reduced to resume mining, and it is of course still in operation a small part of the time.

When it is not feasible to carry the bore-hole below the level of the workings (which is necessary with the usual type of air lift in order to provide "submergence"), what is known as the Jones system of compressed air pumping may be employed. This comprises a direct acting pump operated by compressed air and working in conjunction with a normal air lift. The pump discharges both air and water into a closed tank, from which the exhaust air expels the water through an ordinary air-lift pump. The function of the direct-acting pump is to put a "head" on the water equivalent to that obtained by the submergence which would be necessary for a standard air-lift pump.

Notwithstanding the length of time during which the air-lift system has been in commercial use and the thousands of plants in successful operation, it is still considered more or less fashionable to make a mystery of its operation. This condition has been fostered to a great extent by the number of variable factors entering into the proposition, making it difficult to derive practical working formulas; also by the fact that manufacturers making a specialty of selling and installing these systems have obtained their data and experience at considerable expense and have consequently been unwilling to divulge to the

*Condensed from *Coal Age*.

public the tables used when making calculations. The result is that less is known by engineers in general about the proper design and requirements for an air-lift pump than in almost any other branch of engineering practice.

Since the actual pumping level in a well or a mine is seldom known in advance of a test, it is customary to assume certain conditions of lift, quantity and submergence, as experience dictates, and design the air- and water-piping accordingly.

It is essential that both the air- and water-pipes be properly proportioned because the velocity of flow is a weighty factor, and it is here that experience plays a most important part. If too large a pipe is used the air finds its way through it without doing work. If too small a pipe is employed there will be excessive friction and inefficient expansion of the air bubbles.

LATEST DEVELOPMENTS IN AIR-LIFT PRACTICE.

Engineers specializing on air-lift work have learned much in the last few years. The proportioning of lift to submergence, thorough breaking up of the air, correct sizes of pipes, long sweeping bends and tees and umbrella discharge pieces to allow the water to flow along natural lines with the minimum of friction are all conducive to higher efficiency, better economy and a greater yield from a given source of supply. Along with these minor improvements have come two which are of real importance: One is known as the "booster," and the other, which is of particular interest to mine operators, is the "compound" air lift.

The booster, Fig. 2, is intended primarily for forcing the water, after it has left the regular air lift, through a horizontal or sloping length of pipe to its final destination. The air lift is economical only when lifting the water in a vertical direction, and if it is to be conveyed some distance horizontally from the source of supply it is necessary to either lift it high enough to allow it to flow to its final destination by gravity or to install some supplementary means, such as the booster, to convey it after it is discharged by the air-lift pump.

The booster simply consists of a closed tank into which the air lift discharges. The air and water separate in this tank, there being sufficient pressure on the air to force the

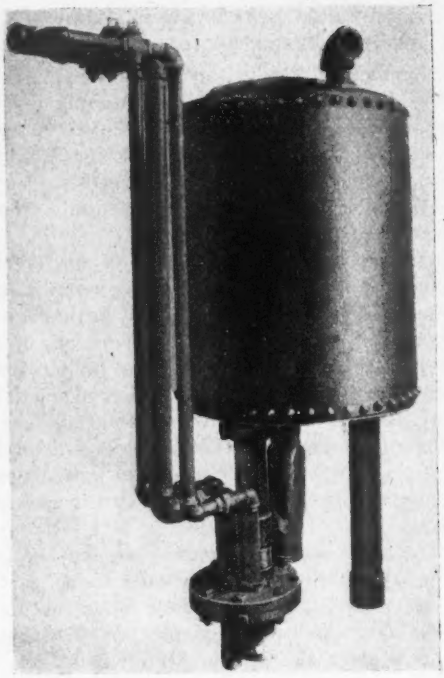


FIG. 2. THE BOOSTER TO DELIVER WATER HORIZONTALLY.

water from the bottom of the tank to its destination. The air escapes constantly from the top of the tank through a restricted opening which maintains the necessary pressure to eject the water. The air discharged is usually piped back to the compressor. The device is extremely simple and forms practically a part of the air-lift pump.

The compound air lift is a recent application of this system to mine drainage. Here a series of short lifts requiring low air pressure are installed in the shaft. Each lift is arranged to discharge into a tank from which the next lift takes its supply. The lifts are low, 11 ft. being considered the most advantageous, since it requires the very low air pressure of 5 lb., which pressure can readily be obtained from centrifugal compressors operated by exhaust steam turbines.

Since there is usually a vast quantity of exhaust steam going to waste around the average coal mine, this form of pump should prove both economical and efficient. Also, since the whole system is designed for only a 5-lb. pressure the piping, etc., can be corres-

pondingly light and cheap; wood-stave pipes can readily be used. The exhaust air from the system should be of considerable aid to ventilation as it would maintain a strong current of air up through the shaft. In the event of a flood the compressor would simply have to be started up and the units above water level would commence discharging, those below coming into action as the water receded. This system has scarcely passed the experimental stage, but offers great possibilities.

In mines equipped with compressed air for other uses an air-lift pump can generally be used to advantage. In mines where no air is at hand the air lift has to stand its chance against other methods of pumping, and only a full knowledge of conditions and good engineering can decide between the two.

AIR DRIVEN DRILLS IN COAL MINES*

The makers of power-driven drills have been many years in fitting them for use in coal mines. The mechanical drill was first invented to work where speed, not cost, was the main consideration; namely, at the Mont Cenis tunnel between Switzerland and Italy. If the work on that tunnel had not been hurried, the interest and running costs would have been prohibitive, and something was wanted which would drill hard rock and drill it quickly. It mattered little if it was a heavy machine, for a number of holes had to be drilled at one time and on one line of entry.

DRILLING SHOTHOLES IN COAL OR SLATE.

But the coal problem is different. The coal can be drilled quite readily by hand, and only a few holes are necessary to shoot it down. So the main need is for an easily transportable drill not needing a truck to move it, which can be handled without a scaffold, a car or a drilling column, and capable of being operated in the narrowest of places or with the operator perched on a ladder. It must be available without any previous preparation for its use, except the connection with a pipe line such as is always in place when an ordinary coal puncher is in use.

And that kind of a drill has been long in appearing. Now that it has come it is quite likely to displace the old hand-drilling outfit, except perhaps where it is possible to sink holes with a breast auger. There is much trouble in drilling a hole in hard or sulphury coal, in slate or in clay. The preliminary sinking of a hole in floor and roof, the bringing up of a heavy extensible drilling post, placing it in position and then drilling, often in cramped quarters, takes much time and involves much labor. The work is by no means simple, even though it is done by hand.

With a 40-lb. Jackhamer drill there are no delays except to bring up the drill, connect it to the airline and hold it to the work. In even sulphury coal it will advance a foot in a minute, and so save time and the hardest kind of labor. The frequent trips to the blacksmith's shop, the broken drills, the uncertainties in coal production, the general discontent which prevail in a camp with hard coal, are all avoided. So little is known about the time expended on the various elements of coal mining that most operators are unable to tell what the items of drilling cost. Drilling certainly is no negligible item anywhere, and in some coals it is one of the most distressing.

T. B. Young states that when he was mine superintendent at Aladdin, Armstrong county, Penn., he found he could drill a 4-ft. hole with a Jackhamer quicker than he could set up a post drill to do the work. One man with a Jackhamer would do more than two men with a post drill.

Those who are using the Jackhamer find, moreover, that it can be used everywhere. It has been found valuable in the sinking of holes for trolley hangers, for which it is not too heavy. But if it is light enough for coal it is nevertheles heavy enough for drilling limestone. One man in lifting bottom in this material averaged 40 ft. per shift and drilled 1½-in. holes. This was at the mine of S. M. Hamilton & Co., at Wellscreek, Penn. Another man working for the Rockhill Iron & Coal Co. says he can bore a 6-ft. hole in solid limestone in 22 min. and can drill a hole of that depth without cleaning.

A PROSPECT HOLE IN ROCK 30 FT. DEEP.

In December of 1914, at the Staunton colliery of the Harleigh-Brookwood Coal Co., near Mahanoy Plane, a tunnel was driven by the Portland Contracting Co., and the contractors desired to know how near they were to some old works and if they contained wat-

*Compiled by Editors of Coal Age.

ter. M. C. Reed, in describing the method of exploration, says:

"Having no prospecting drill we decided to drive the hole with a Jackhamer, using four pieces of steel, 3, 6, 9 and 12 ft. long, sharpened to a 2-in. gage. After drilling 12 ft. with this set of steels we welded a bit into a 2-ft. length of 1-in. pipe and a shank into another pipe. Then with extra heavy couplings we connected these to a 10-ft. length of the same size of pipe and drilled the additional 2 ft. without finding the old workings.

"Being so successful with this innovation we had the bit re-sharpened and added another 2-ft. section of pipe and proceeded to drill again. We continued in this manner, resharpening the bit and adding 2-ft. sections of pipe, until we found the old workings at a distance of 30 ft.

"The hole was drilled through a hard slate formation on about a 6 deg. pitch, and the Jackhamer rotated the steel perfectly until the hole was finished. It would be interesting to know how far we could have drilled, because the way the outfit was working when the hole was finished makes us feel we could have gone several feet further. However the size of the hole would soon have stopped us because of the size of the extra-heavy couplings. The diameter of our bit was about 1⅝ in. when the hole was finished."

Mr. Reed says he is drilling 12-ft. holes every day with the Jackhamer drill and is experiencing no difficulty in so doing. A prospecting drill costing about $750 would have done the work, it is true, but the flexibility of the Jackhamer is most convincingly proved by this work, for which, of course, it was never projected.

TUNNELS DRIVEN ONLY 30-IN. SQUARE SECTION.

To show the varied work to which the Jackhamer is adapted that done at Pax, W. Va., and cited by John Lindley, of the New River & Pocahontas Consolidated Coal Co., may be quoted:

"We have driven 11,460 ft. of narrow entry, including 7,868 ft. of 10-ft. entry, 3,292 ft. of 12-ft. entry and 300 ft. of 22-ft. entry. The slate in these roadways ran from 1 ft. to 18 ft. in thickness and averaged about 6 ft. Four overcasts were constructed, three of which have a cross-sectional area of 76 sq. ft. and the fourth of 104 sq. ft.

"Two waterway tunnels were driven, each 50 ft. long and 2½ ft. square. Such a small opening could not have been driven with any other drill and is quite unusual, but we desired to drive a tunnel of minimum dimensions. A ditch was constructed 125 ft. long, 18 in. wide and 3 ft. deep and another 50 ft. long and 18 in. deep, also with the help of the Jackhamer. The excavation in solid rock of a pump room 9x12x18 ft. has just been completed with the aid of the same handy tool.

"Our shaft is concrete-lined and very wet. We desired to make water rings in the solid concrete to drain the water to the sump by means of pipes. To do this we tapped our air line at the surface and swung a hose line down the shaft. We then took a Jackhamer drill, and working from the cage, drilled holes 4 in. deep in the sides of the walls, sloping downward and as near together as possible. Afterward we smoothed and pointed the work with hand drill and hammer so as to make a continuous ring trough around the shaft.

"In this manner we constructed three rings which carry the water to one end of the shaft from whence it is piped to a reservoir (also made by a Jackhamer) and pumped to another reservoir on the top of the hill. The water being pure it is used for the supply of the camp. Our best drilling with these Jackhamers was one 6-ft. hole in slate in 8 min. and six 6-ft. holes in coal in 24 min. The driller in making these results did not know he was being timed. He said he had drilled a slate hole 6 ft. deep in 5 min. when he was putting forth his best efforts. We are averaging 200 ft. of drilling per shift with two Jackhamers and four men. These men move from place to place and lay their own pipe lines.

"It is impossible to tell all the different positions and places in which we have used Jackhamer drills. We worked from small trestles of 2x4-in. lumber built up 6 to 15 ft. above the ground, supports which would have been wholly inadequate for the columns of other makes of drills. Since we started using the drills, the cost of upkeep has been comparatively small, not over $100 including a new set of bits, six extra 12-in. bits and one extra 36-in. bit."

ONE HAND-DRILLED HOLE COSTS AS MUCH AS 43 BY MACHINE.

At the Edgewater Mine, Ensley, Ala., the compressor recently broke down and the Jackhamer was put out of commission in con-

sequence. Two men were put to drill a hole by hammer and steel. In three hours it was completed. The combined wages of the men was 50c. per hour, so the hole cost $1.50. As soon as the compressor was running the same amount of work was done in 7 min. with a wage charge of 30c. per hour. So the hole as made by the Jackhamer cost only 3½c. That same Jackhamer ran two years without a cent of repairs.

At a mine in central West Virginia a Jackhamer was used to drive through a "want" where the coal was replaced by white sandstone of an extremely flinty character. The heading measured 6x20 ft. The cost of driving the roadway without the drill was about $40 per yard; with it, it was driven for $22.

At the Black Joe mine in Kentucky, the trolley-wire hanger holes were put in by two men with a hammer and steel. In a whole day they put in 9 or 10 holes from 4 to 6 in. deep. One man with the Jackhamer can drill 9 or 10 holes in 10 or 15 min. At the same place a coal hole 5 ft. deep has been driven in 2 min.

R. G. Johnson, of the Dravo Contracting Co., states that largely by the help of three Jackhamers he sunk a 350-ft. shaft and lined it with concrete and put in a steel ladderway. His repair bill on the hammers was only $12.42. In establishing this record during the month of May the shaft was sunk 126 ft. and lined completely.

DRAINING A SWAMP BY AIR LIFT

At the American mine, Diorite, Mich., J. R. Thompson, manager and part owner, has devised a novel method for removing the water from a large swamp which lies above some of the mine's ore deposits. The swamp is about 2 miles in length and 1 mile in width, containing a great deal of water, and it was feared that if it ever came into the workings in large quantities it would cause trouble. To get rid of the water was considered quite a problem, but Mr. Thompson did some figuring and believed that he could solve it. He had a diamond-drill company put down several holes in the swamp, to find how close the ledge was to the surface, which would give some idea of the amount of water that the swamp held. The drills showed that the ledge varied from about 70 to 125 ft. below the surface. On the top there was about 10 ft. of black muck, with quicksand and gravel below. The diamond-drill firm was asked to put down several 8-inch holes to the gravel, but its engineer stated that the task would be too great, as the quicksand would cause difficulties. Mr. Thompson then undertook the work himself, putting down the first pipe a distance of 76 ft. in three days after the tripod was rigged up. The pipe was not touched with a hammer. It was sunk by turning, and, with an auxiliary pipe, forcing air down the inside at the same time. When the pipe was bottomed in the gravel the air caused the water to shoot to the surface. This pipe is now producing about 1,000 gal. per min. Since that time five more pipes have been put down, some of them reaching a depth of over a 100 ft. One went through the gravel, being put down deeper than any of the others, and no water is now flowing from it. An attempt was made to blast it off higher up, but without success. One of the other pipes is also inactive. The four that are now working are sending about 5,000 gal. per min. to the surface. Two of the pipes are 10 in. in diameter, but they do not give any better results than the 8-in. pipes. This system of air-lift has lowered the water level in that huge swamp over 20 ft. during the short time that it has been in operation. When most of the water is out, a drift will be extended from the 140-ft. level of the mine and a 3,500-gal. centrifugal pump installed to care for any water that comes into the swamp later on. The method is very cheap, as the pipes need no attention after they get in operation. Some idea of the force of the water can be gained from the fact that granite rocks weighing as much as 8⅝ lb. were brought to the surface through one of the pipes. The water coming from below runs into a ditch that was made by using dynamite and forms quite a sizable stream.—*Eng. and Min. Journal.*

As a memorial to the late Dr. Joseph A. Holmes, director of the Bureau of Mines, of the Department of the Interior, the Colorado School of Mines has established the Joseph A. Holmes Professorship of Safety and Efficiency Engineering.

THEORY OF TWO-STAGE VACUUM PUMPING

BY R. S. HOWARD.

It has been the custom of some builders of dry-vacuum pumps to employ a two-stage unit with the seemingly peculiar feature of having the two cylinders the same size. At first thought there would appear to be no good reason for this, any more than for making a compound steam engine with the low-pressure cylinder the same size as the high-pressure. In the case of the steam engine it is difficult to see how any compounding could be accomplished with such an arrangement, and in the case of an air compressor (which is just what a dry-vacuum pump is) it would at first appear equally ineffective.

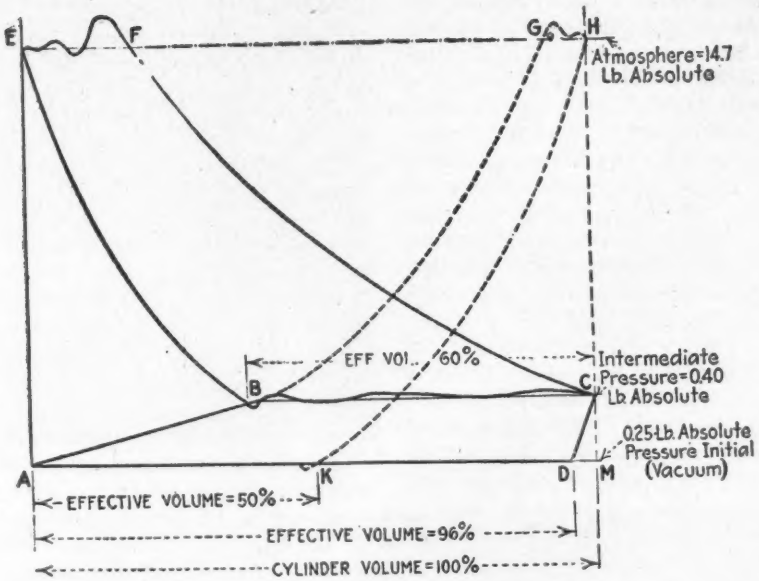
In the compound vacuum pump the effect of the cylinder clearance is so marked that this feature alone serves to create an actual effective cylinder ratio greater than unity, even with equal cylinder sizes, resulting in an actual compound compression (or exhaustion) the sole object of which is to increase the volumetric efficiency, or air output.

It is well appreciated that any cylinder must have a certain amount of clearance volume, or dead space through which the piston does not travel. This is made up of the necessary clearance between piston and cylinder head, which is made as small as is consistent with safety, and also the cavities and ports leading to inlet and discharge valves. The effect of this waste space is to trap some of the air as it is compressed, instead of allowing it to escape through the discharge valves. Then on the return, or suction, stroke of the piston this trapped air re-expands, helping to move the piston, it is true, but also helping to occupy space which should be taken up by incoming air. Whatever clearance air is thus allowed to expand keeps out just that much new air and so cuts down the intake and output of the pump. The greater the compression, the greater the amount of air that will be squeezed into this clearance space and the greater the amount of re-expansion on suction strokes to keep out the incoming air. Therefore, as the number of compressions increases, the less will be the relative amount of air delivered by the pump, and as the compressions increase rapidly with higher vacuum (26-in. vacuum is about 7¾ compressions, 28-in. vacuum is 15¾ compressions, while 29-in. vacuum is nearly 33 compressions), it follows that the volumetric efficiency of the cylinder decreases rapidly as the vacuum becomes higher.

Now, consider a compound vacuum pump that has a cylinder ratio of 2 to 1; that is, the low-pressure cylinder has twice the piston displacement volume of the high-pressure. It is evident that, clearance effects neglected, the low-pressure cylinder will deliver air to the high-pressure cylinder at some pressure intermediate betwen that of the vacuum from which it is pumping and the atmosphere or final-discharge pressure. As a matter of fact, with a cylinder ratio of 2 the intermediate pressure will be somewhere around 2¼ times the absolute vacuum pressure, depending upon the amount of radiation surface provided between cylinders. If there is an intercooler between and the air is cooled back to the initial intake temperature, the absolute intermediate pressure will be twice the absolute vacuum pressure (Ratio × initial pressure).

The effect of this intermediate pressure is to divide up the total number of compressions between the two cylinders, so that the low-pressure cylinder will be pumping through a much smaller range. Thus, assume a vacuum pressure of 1.5 lb. absolute, with a cylinder ratio of 2, giving an intermediate pressure of about 2¼ × 1.5 = 3.38 lb. absolute. Then the number of compressions in the low-pressure cylinder will be $\frac{3.38}{1.5} = 2.25$; whereas, with only single-stage pumping the compressions would have been $\frac{14.7}{1.5} = 9.8$. From the foregoing regarding the effect of clearance it follows that much less air will be trapped in the clearance space with only 2¼ compressions than with 9.8. Hence, the volumetric efficiency of the compound machine will be much higher than that of the single-stage.

If, instead of having a cylinder ratio of 2 to 1, we reduce it to 1.5 to 1, the intermediate pressure will be that much lower, the low-pressure compressions will be reduced, the clearance effect will be less and the machine will deliver more air. This process may be continued until finally the two cylinders become the same size, or the



Cylinder Volume Ratio=1
Cylinder Effective Ratio=$\frac{96}{60}$=1.6=Low-pressure Ratio of Compression
Approximate Intermediate Pressure=1.6×0.25=0.40 Lb Absolute
High-pressure Ratio of Compression=$\frac{14.7}{0.4}$=36.7
Total Ratio of Compression=$\frac{14.7}{0.25}$=58.8

SINGLE-STAGE AND TWO-STAGE VACUUM PUMPING.

cylinder ratio becomes unity. Here it would seem the effect would become lost, because there would appear to be no intermediate pressure. This is where the clearance volume has a marked effect. It will be noted that if pumping from a given vacuum, say 1.5 lb. absolute, the total number of compressions will be $\frac{14.7}{1.5}$ = 9.8, we accomplish 2¼ compressions in the low-pressure cylinder, the high-pressure cylinder must furnish the rest, or $\frac{9.8}{2.25}$ = 4.36. Again, with the same vacuum, if we accomplish 1.5 of the compressions in the low-pressure cylinder we must have $\frac{9.8}{1.5}$ = 6.54 compressions in the high-pressure cylinder. As the number of compressions in the low-pressure cylinder decreases, that in the high must increase to make up for it. The effect of decreasing the compressions in the low-pressure cylinder, we have seen, will increase its volumetric efficiency due to reduced clearance loss, so that the accompanying effect of increasing the number of compressions in the high-pressure cylinder will decrease its own volumetric efficiency due to its own clearance effect. The result of this is that the lower the cylinder ratio the more air the low-pressure cylinder will pump and the less air (cubic feet) the high-pressure cylinder will pump. This at once causes the low-pressure cylinder to build up an intermediate pressure higher than would result from the piston-displacement volume ratio only, so that even when the piston-displacement volumes of the two cylinders are identical there is an actual intermediate pressure and the machine is a true compound pump of greater output than a single-stage pump of the same size.

In the accompanying illustration will be found a set of diagrams which should help

to make the conditions clear. First, consider a single-stage pump. Let the initial pressure of the vacuum be 0.25 lb. per sq.in. absolute, and discharging at atmosphere, of course. The indicator diagram would look something like the figure *ABGHK*. The amount of air handled per stroke would be represented by length *AK*, if *AM* represents the full stroke of the piston. The diagram shows the intake air (and the delivery) to be 50 per cent. of the piston displacement, the curve line *HK* (dotted) shows the reëxpansion of the air trapped in the clearance space.

Instead of a single cylinder, let the machine be provided with two (compound) cylinders in series, each of which has the same displacement, namely, lenth *AM*. After operation for a few strokes the respective volumes and pressures will have adjusted themselves to the conditions shown by the two indicator diagrams *ABCD* and *CFEB*, the former being the first-stage, or low-pressure, diagram and the latter the second-stage, or high-pressure. With this set of conditions it will be seen that the creation of an intermediate pressure *BC* of 0.40 lb. absolute produced a reëxpansion curve *CD*, in the low-pressure diagram, indicating an air intake of length *AD*, or 96 per cent. of *AM* the whole cylinder volume, instead of only *AK*, or 50 per cent. of cylinder volume shown before. The intermediate pressure is a direct result of the lesser volumetric efficiency of the high-pressure cylinder, which itself results from the greater number of compressions in that cylinder, reëxpanding from the clearance volume.

If there is no intercooling of the air discharged from the first cylinder before it enters the second cylinder, the length of low-pressure dicharge line *BC* must represent the volume taken into the high-pressure cylinder, shown to be 60 per cent. of the piston displacement of that cylinder. The line *EB* represents the curve of greater reëxpansion from the clearance of the high-pressure cylinder, due to the greater number of compressions or greater range of compression in that cylinder.

WILL IT PAY FOR THE ADDITIONAL COST?

Of course these relative volumes and pressures in any given machine would depend upon the construction, clearance, degree of cooling, etc., of that particular machine. These values have been chosen to show in a rather exaggerated manner just how the actual compounding is brought about with equal cylinder sizes in series and to show the resulting increase in volumetric efficiency thus obtained. The question as to whether the results are worth the extra expense of the double construction is a matter to be decided by the purchaser. Some of the modern high-speed vacuum pumps of single-stage construction are giving such good results relative to their initial cost that the respective merits of different makes should be carefully considered before purchasing any particular style.—*Power.*

TALC AND SOAPSTONE

The United States produces more talc and soapstone than all the rest of the world combined. Moreover, according to J. S. Diller, of the United States Geological Survey, our production has nearly doubled in the last decade, increasing from 91,185 short tons, valued at $940,731, in 1904 to 172,296 short tons, valued at $1,865,087, in 1914. Of talc alone the United States produced 151,088 tons, and of soapstone 21,208 tons.

Talc is a simple mineral of which soapstone is an impure massive form. Few people are aware how much we owe to talc and soapstone. It is one of the softest of minerals. It is so smooth and slippery that it has become a great panacea for friction in many branches of human industry.

There are nine States producing this useful mineral. New York continues to be the leading producer, yielding more than 57 per cent. of the total production of talc in the United States and far outranking all other States excepting Vermont, which has in recent years so greatly increased its production that in 1914 its output was about three-fourths that of New York. Of soapstone, Virginia holds the greatest supply, and backed up by Vermont it meets the great demand for washtubs, sinks, and fireless cookers.

Talc is used in making talcum toilet powder, the tailor uses it to chalk fabrics for new suits, and talc "slate pencils" and crayons have enabled many scholars to solve knotty problems. Talc bleaches our cotton cloth, and in paints we see it everywhere, but its chief use is as a filler in paper of many kinds, from roofing to newspaper.

FIG. 1. PEELING THE TIE.

This of course could not last in these days and there is now a pneumatic tie peeler with which any ordinary laborer, at laborers wages, will thoroughly peel 150 to 200 ties per day. The device employed is an Imperial pneumatic hammer in conjunction with an imperial tie peeling tool. The half-tones tell the rest of the story. Fig. 1 shows the actual peeling of a strip of bark and Fig. 2 is a view of a complete tie peeling outfit in a railroad yard. The light portable compressor outfit comprises an Imperial vertical single-acting compressor driven by a gasoline engine, with air receiver and all accessories costing approximately $300. The Imperial hammer used can also be used for chipping, calking and general repair work by the insertion of the appropriate tools in place of the peeler.

FIG. 2. COMPLETE TIE PEELING OUTFIT.

THE PNEUMATIC TIE PEELER

Railroad ties are flatted on two faces to a standard thickness, but to greatly prolong the life of the ties it is found necessary to peel the bark from the other sides. This has heretofore been a laborious and costly operation. The average peeler will do from 40 to 60 per day, receiving wages considerably above these of a common laborer. When piece work is the rule the prevailing price is 5 cents per tie.

A CODE OF RULES FOR METAL MINES

A publication of considerable interest to the metal-mining districts of the United States has just been issued by the Bureau of Mines, under the title, "Rules and Regulations for Metal Mines." It is to be known as Bulletin 75, and the authors are W. R. Ingalls, J. Parke Channing, James Douglas, James R. Finlay, and John Hays Hammond. The Committee was originally appointed at a meeting of the American Mining Congress at Denver,

Colorado, in November, 1906, and its object was the drafting of a modern law governing quarrying and metalliferous mining, which could be recommended to the several States for adoption.

This committee did considerable work and made a number of reports. In April, 1911, Dr. Joseph A. Holmes, Director of the Bureau of Mines, invited the committee to serve as a committee of that bureau with the idea of preparing a final draft of a law, and this was accepted.

The code of mining rules that has been finally drafted by the committee is the coordination of the experiences, opinions, and suggestions of a great many men who have assisted the committee in an advisory capacity and as directly employed aids. The former have included many engineers actively engaged in practice, members of professional societies, and members of the bar; the latter have included members of the regular staff of the Bureau of Mines and of the personal staffs of members of the committee. The committee has sought to obtain many points of view and to summarize many experiences. The draft that has been prepared is not offered as the last word upon this subject. There are many phases of this subject with which the committee has been unable to deal thoroughly. Thus the committee confesses its inability to formulate at the present time adequate rules covering the important subject of ventilation of mines. Similarly there are many practices in open-cut mining, by steam shovels, etc., regarding which the committee has felt unable to formulate rules. It is felt, however, that the rules so far as prescribed may advantageously be applied to open mining whether it be simple quarrying or the extraction of metalliferous mineral, as well as to underground mining.

In spite of the popular impression that the introduction of concrete, steel and brick is doing away with the use of wood, the State of New York is using more wood per capita than ever before. More than twice as much wood is used per person now than fifty years ago. More than six times as much wood per person in New York State than in Germany, and more than ten times as much as in Great Britain.

THE BAROMETER, OUR FEELINGS AND HEALTH

BY CHARLES E. BANKS.*

Every person capable of putting two and two together and obtaining the correct answer has been conscious of feeling out of sorts, as the printer would say, when the clouds hung low and the sun was obscured. A week of dull weather sets a whole community on edge, and the mental, moral and physical components of man are, at its close, about fit for the scrap heap. Under such atmospheric conditions, when prolonged for a number of days, an Englishman admits that he feels "seedy" and the American confesses that he is feeling "mean," both adjectives relating to a state of mental and bodily dumps.

This situation is generally attributed to the lack of sunshine, for every human being retains the ancient beliefs in the potentiality of the sun in its relation to his life and its well-being. A few sunless days or hours are not sufficient, however, to put a hoo-doo on the temperament and activities of a whole population; there is another important controlling agency, but little understood, even if appreciated, and it exercises a much greater influence than the sun in a given space of time. If the sunlight were absolutely necessary to our upkeep night-watchmen and laborers on the morning editions would be chronic invalids, and mine workers the most unhealthy people in existence.

The gaseous envelope of atmospheric air surrounding the earth is the medium in which we have to live, and it bears the same relation to the human family as the waters of the globe to the order of fishes. The air and water are essential to the life, as much a factor to man, as the quality of water to the fish. This normal atmospheric air exerts on our bodies a definite dynamic force, or physical pressure, of 14.7 pounds on every square inch of our bodies if we live at or near the sea level, and the higher up we go this atmospheric pressure diminishes until on the heights of the Rockies it is three or four pounds less. The normal pressure at sea level is indicated by the barometer as 30 inches, and it decreases by an established scale as it ascends these mountain heights. Most

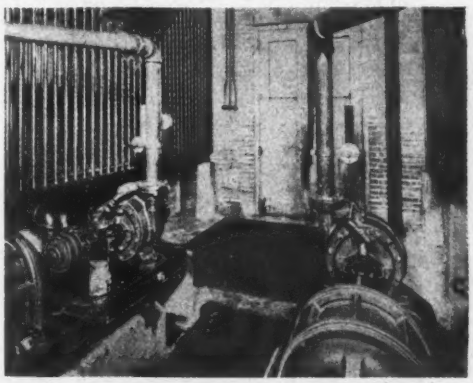
*Surgeon U. S. Public Health Service.

persons know that ascents of mountainous peaks, thousands of feet above sea level result in marked physical distress, difficult breathing, general depression at the summits, and in extreme cases bleeding at the nose and even from the lungs, due to this lessened atmospheric pressure. Just so it happens that when the barometer is "low" for a considerable period, say a drop from 30, the normal gage, to 29 or below, when stormy or dull weather ensues, we get the analogous effect imperceptibly, but in an appreciable degree; for it has happened that a definite measure of atmospheric pressure has been released from our bodies and naturally there follows a dislocation of our normal balance. The average adult man sustains on every pleasant day an atmospheric pressure of about fourteen tons at sea level, when the barometer reads at 30 and a drop of an inch or more, to 29 and below practically takes off half a ton or more of his load to which he is accustomed. Paradoxically, instead of feeling lighter and freer man feels a depressing effect on his tissues. He has to become adjusted to this alteration from normal tensity to one of unusual relaxation, and, while it is slow in its manifestations, as barometric changes are generally gradual, yet the effect in miniature is like going up to a great height on a mountain range. Of course this feeling is neither serious nor fatal, but the relaxed condition in unpleasant weather extending over a number of days makes us feel "out of sorts." While the spell is on we are in the doldrums, and the situation is recognized as of enough importance by careful surgeons to defer important operations, which can be postponed, when these unfavorable barometrical conditions prevail, and the patient needs every ounce of vitality to pull through.

AN EFFICIENT AIR WASHER AND COOLER

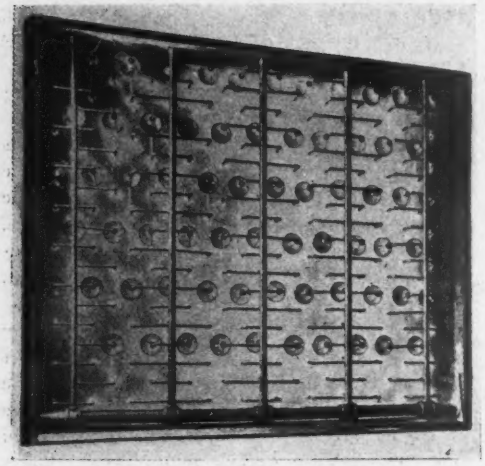
The Metropolitan Street Railway, Kansas City, Mo., has recently completed the installation of two air washers in connection with its largest turbo-generating plant at the corner of Second Street and Grand Avenue, and the company's engineering department now announces the successful outcome of its tests of the machines, which have a capacity of 80,000 cu. ft. per minute each. The installation includes complete equipments of motors, pumps, patented spray nozzles, spray piping, screens, eliminator plates and other necessary appliances.

According to the railway officials, the expense of installing and operating the air washers has been more than justified by the results obtained—the removal of practically all the dust in the air entering the washer and the cooling of the air to the wet bulb temperature, thus increasing the capacities of the turbo-generators from 12 per cent to 15 per cent. The installation will undoubtedly prevent expensive burn-outs that are liable to result from carrying overloads, with an accumulation of dirt on the windings, and is believed by the railway electricians to constitute an effective insurance against the losses due to decreased efficiency and the delays required for repairs and cleaning the generator windings.



PUMP AND TEMPERING COILS.

The new machines, shown in the accompanying illustrations, were purchased by the Metropolitan Street Railway from the Spray Engineering Company, Boston, Mass., which followed its usual custom in erecting them for the purchaser. About 350 ft. of 1-in. galvanized steam piping were included in the equipment of each washer, to be used as tempering coils to reduce the humidity of the outgoing air, when required. These coils are constructed so as to operate satisfactorily under a steam-gage pressure of 5-lb. per square inch. The air-washer equipment furnished renders it unnecessary to have any extra equipment for washing down the eliminator plates, thus considerable expense is avoided. The eliminators consist of vertical plates, so arranged as to provide a large wet surface.



SPRAYING EQUIPMENT.

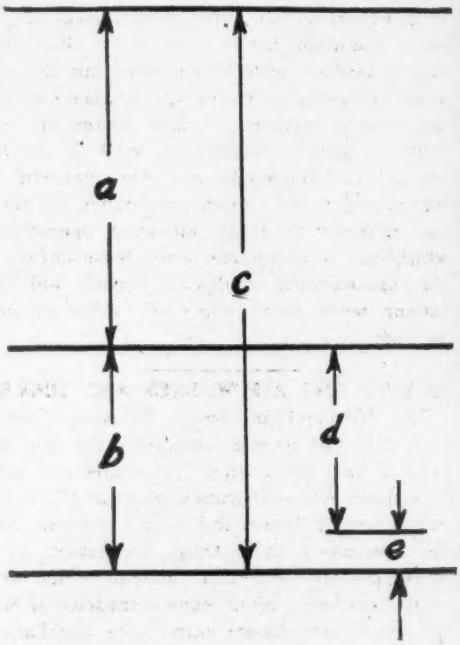
The washers are guaranteed to operate efficiently for ten years.

Each pump unit of the machines is mounted on a heavy cast-iron bedplate, so constructed as to extend under all parts. This arrangement prevents oil and water from dripping from the pumps and motors on to the floor, the bedplates being flanged and set at an incline so as to give perfect drainage. The motors are capable of operating without deterioration in a moist atmosphere from 40 deg. to 50 deg. Fahr., and the pumps operate readily with a 60 per cent. efficiency. All piping and fittings are of galvanized iron to prevent corrosion incident to a humid atmospheric condition.

The tests made in Kansas City have interested a great many electricians of the South west who came to witness them. The assistant electrical engineer reports that in the tests thus far made, the washer passes no free moisture that will show on a plate of clean glass held at a distance of 8 in. from the eliminator. The test for cleaning consisted in sifting 5 lb. of dry boiler soot into the mouth of the washer at a temperature of 70 deg. At the same time, a sheet of clean white paper was held at right angles to the air flow at about 6 in. from the flow openings. This test was conducted for ten minutes, after which not a trace of soot could be found on the paper. With a view to seeing what result would show in the case of the finest dirt, two wire screens were covered with a thin film of absorbent cotton, and one of these was inserted in the air duct to intercept the air as it entered the washer, while the other was placed in the duct leading from the washer. The first screen was allowed to remain in the air current continuously for six hours and the second for two weeks. At the end of the latter period it was found that the second screen showed no more soiling than the first, which had been exposed for the shorter period.—Electric Railway Journal.

PRESSURES AND VACUUMS

The little sketch by Professor E. W. Kerr, of Louisiana State University and here reproduced from the *Louisiana Planter,* shows the rather anomalous way in which vacua are indicated and recorded as compared with positive pressures. Steam pressures above otmosphere were formerly measured by the mercury column and stated in inches of mercury, but as higher pressures become common the mercury gage was abandoned and all pressures are now stated in pounds per square inch. Vacuum is still mostly measured in inches of mercury, although here too pounds would be more convenient. When we say there are 26 inches of vacuum we mean that the pressure is 26 inches *less* in



PRESSURES AND VACUUMS.

the vacuum chamber than the pressure exerted by the atmosphere, which continually varies within narrow limits for each locality, but at sea level averages approximately 30 inches of mercury or, say, 15 pounds to the square inch.

In the sketch the inner horizontal line represents the pressure of the atmosphere and the lower line represents the entire absence of pressure, or perfect vacuum. The upper horizontal line may represent any gage pressure, or pressure in excess of that of the atmosphere. Then of the several vertical lines, *a* is gage pressure, *b* is vacuum and *c* is absolute pressure. If *d* represents the actual vacuum in the condenser of a steam engine then *e* will be the difference between the condenser vacuum and perfect vacuum. With an atmospheric pressure of 30 inches of mercury, and a condenser vacuum of 26 inches, *d* would represent this 26 inches, and *e* would be 30-26 =4 inches.

In a working cylinder with the steam pressure against one side of the piston 20 pounds, gage, while on the other side there might be 26 inches of vacuum, the total force operative upon the piston would be determined by adding the vacuum to the pressure, but unfortunately the units are in quite different denominations.

It is to be noted, by the way, that the value of the mercury column is not precisely 2 inches to the pound as it is so convenient to assume. An inch of mercury represents .4915 pound, and this can be used as a multiplier. Then 26x.4915 12.78 pound and the total driving force per square inch of piston as above assumed would be 20+12.78=32.78 pound.

It seems rather strange that manufacturers of vacuum gages, while still retaining the reading in inches of mercury, do not also give another circle of graduations reading pounds, but we do not know of any such gage on the market.

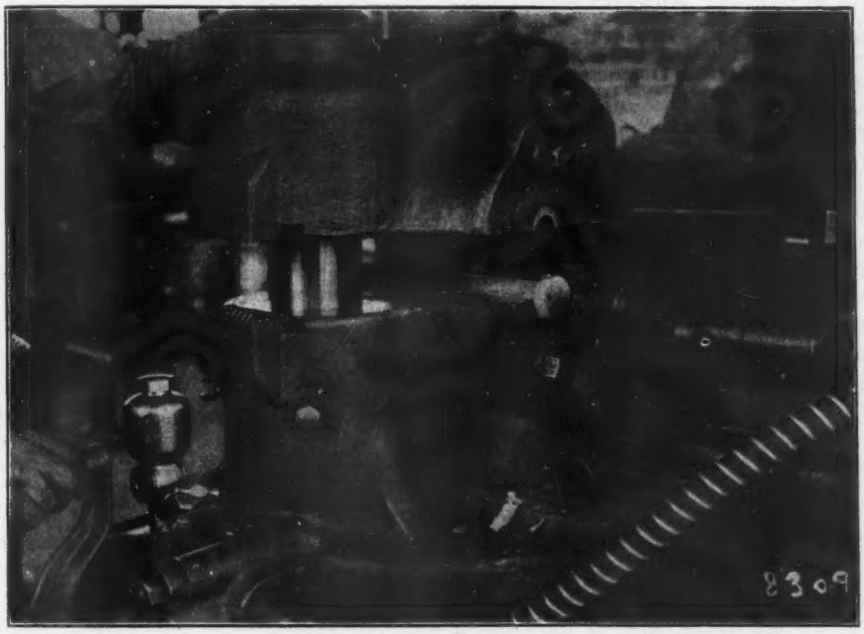


FIG. I.

A LEYNER DRILL SHARPENER MAKING COUPLING PINS

A Leyner drill sharpener in the shops of a coal mining company was recently fitted with special dies for forging coupling pins for mine cars. This resulted in a considerable economy of the blacksmith's time.

For this purpose a piece of iron stock 1¼ in. in diameter and about 14 in. long is placed in the dies, projecting about 2 in. The flat-faced hammer or dolly upsets the head, as shown in Fig. 1, bringing down the length of the pin to

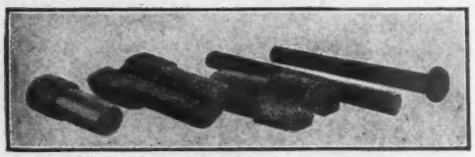


FIG. 2.

about 12½ in. The machine operates with compressed air and is controlled entirely by a single lever.

By equipping the sharpener with suitable dies and dolly the pins were turned out at the rate of about two per minute. This rate could have been even greater if it were not that there were only three forges in use and they could not supply the heated stock any faster.

Fig. 2 shows the special dies and dolly used for forging these pins, as well as a blank and a finished pin. It is planned to make other special dies and dollies so that the machine can be used for miscellaneous blacksmith work, such as welding car couplings. In addition to this special work, the sharpener is used for pointing various styles and sizes of drill steel used for cutting rock and coal in the mine.—*Coal Age.*

GAS ENGINES AT EXTREMES OF ALTITUDE

I venture I have the distinction of using two Foos engines at greater extremes of altitude, than any one else. One is at just 10,000 feet altitude and one at 198 feet below sea level.

For the past two years I have been running a Foos gas engine at my mine in Mono County, at the above elevation, as shown by the Government survey and checked by several aneroids. This engine is used for hoisting gold ore from a 200-foot shaft, and hoists a 700-pound bucket in one minute and seven seconds. It has never refused to do the work required of it, and has never delayed us ten minutes on account of engine trouble. This is a 7 h. p. engine and I first rigged it to a small hoist to do the prospecting work. I found it so very satisfactory that I have continued it as a permanent power.

Showing extremes, I will say that, on account of the excellent work my engine at the mine is doing, I purchased a small one to pump water at Calipatria, and it is working every day at a point 198 feet below sea level. I see no difference in the working of the two engines, except that I have to give the mine engine all the air I can, which I have done by taking out the air pipe entirely, and drilling the hole larger.—H. H. Clark in *The Gas Engine.*

UNEXPLODED DYNAMITE CHARGES SAFELY REMOVED BY AIR

By inserting the end of a hose, or short length of pipe, in a blast-hole that has failed to go off, turning on a light pressure of air through a valve from the drill line, and withdrawing the pipe with the pressure on, the unexploded dynamite may be removed with safety. The work should be done with care, and too much air pressure should not be turned on. This method was advocated by Jacob S. Langthorn, in a paper read at a recent meeting of the Brooklyn Engineers' Club, in preference to attempting to drill a new hole alongside the unexploded one. The latter practice is compulsory in New York City, under section 188 of the rules of the Municipal Explosives Commission.

The paper, which outlined the effective methods used in handling explosives on the Catskill Aqueduct tunnels, and the discussion which followed, dealt with tunnel practice, where the holes in the heading are all drilled at an angle. No one can be sure where the end of such a hole, 8 or 10 ft. from the face, is located, and when one of them has missed, it was asserted, it is dangerous to drill another hole anywhere near it. That the practice of attempting to drill a new hole in a tunnel heading where one or more holes of a round have missed is much more dangerous than withdrawing the unexploded charge with care, especially where compressed air is used. was unanimously asserted by several tunnel engineers of wide reputation, who took part in the discussion of the paper. John R. Healy, inspector of combustibles of the Bureau of Fire Prevention, stated that where compressed air was used as described the charge followed the pipe out of the hole as if it were a piece of iron and the pipe powerful magnet.

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HOPE FOR MEXICO

In the last full week of August there came to hand, one after the other and not together, the issues of the Mexican Mining Journal for the successive months from March to August, inclusive. It seems quite clear that these have been held up somewhere on the way by the demoralization or paralysis of the mail and transportation systems of the unfortunate country. The fact that the papers have come to hand at last seems to show that things are improving and that normal conditions are being resumed.

We are pleased to note that there has been no demoralization of the editorial department, or in fact any department, of the publication referred to, and that the issues now before us are certainly as good as any we have ever received, or in fact better. The editorial in the August issue, which we here reproduce, it will be seen is overflowing with virile optimism. It is entitled:

MEXICO'S WONDERFUL VITALITY.

"Although conditions have been so unfavorable, during the past few years, at least in southern Mexico, that 'Mining! There ain't no such thing!' has been a favorite expression among mining men in the capital city, yet the mineral production of the country continues to be an important factor in the world markets. The recent drop of nearly three cents in the New York quotations for silver are said to be directly due to a huge shipment of accumulated bullion from Pachuca. Of course Pachuca is an exceptional camp even for Mexico, and the conditions which made it possible for the mines to continue operations there almost without interruptions were also exceptional. Nevertheless this isolated and exceptional circumstance gives one a sense of the importance of the country and its mines in the mineral industry of the world. If the mines of Mexico can still disturb the markets of the world after years of turmoil, stagnation and decadence, what can they not do when conditions favorable to enterprise and expansion once more return to the country? Another note found hidden among the rare cable despatches which we are still permitted to see, bears witness to the latent vitality of the country. It seems that in spite of five years of upheaval preceded by an equal period of apprehension,

Mexican bonds are still quoted in foreign markets at a higher rate than those of certain countries in South America and Europe which enjoy a settled and apparently stable form of government. Evidently there is still plenty of confidence in the future of Mexico, and it is not likely that those of us who have waited courageously for the country to recover its political indigestion and for the return of prosperity will in the end be disappointed."

THE EXPLOSIVE AGE

In this cataclystic era "explosion" is a term oft used, and we are not at all surprised now to find our bright little New York contemporary, the COMPRESSED AIR MAGAZINE, asking, "Why should not the present be called the age of explosives, or, perhaps still better, the explosive age?" War projectiles apart, our contemporary finds utilitarian science justify its claim, as it feels that in the exhibits at this season of county and state agricultural fairs nothing is more striking than the completeness with which the explosive engine, the gasoline motor, has superseded the steam engine. The Humphrey pump and the Diesel engine are, our contemporary admits, beginning to show the applicability of the explosive motor to the largest power units, in which direction, of course, compressed air helps. Hence is a case made out for thus dubbing the age, and the only alternative title we can suggest, having in mind the insensate folly of those who wrack and burn, is that which one applies to the inferno itself—combustion.—*Gas and Oil Power*, London.

THE LATEST COMPRESSED AIR MIRACLE

The following is taken from the New York Evening Sun, Aug. 31. It is certain that no other device than a "compressed air machine" could have done all that is alleged, and no one at all acquainted with "compressed air machines" could have given out such a batch of absurdities.

John Dillon, superintendent of the Degnon Construction Company, who is in charge of the work on the new subway at Fifty-ninth street and Sixth avenue, was arraigned before Magistrate Deuel in Yorkville Police Court to-day on complaint of Patrick Hanan, chief inspector in the Department of Water Supply, who charges him with violating an ordinance that forbids any one from making connection with a city water main without a written permit from the department.

Inspector Hanan charges that the company "tapped" a water main at Sixth avenue and Fifty-ninth street and has been using the water for five months.

It is further alleged by Hanan that the construction company used a compressed air machine in obtaining water from the main and that this machine blew poisonous gases into the water main which tainted the water.

He also alleged that the compressed air machine made the water meters in the vicinity of Fifty-ninth street and Sixth avenue register backward instead of forward.

The queer action of the water meters puzzled the Department of Water Supply for some time. Investigation led to the charge against Dillon.

Magistrate Deuel told Inspector Hanan that a police court had no jurisdiction in such a case. He advised Hanan to have the city bring suit in a civil court against the construction company.

FOURTH OF JULY DRILLING CONTEST

At Wallace, Idaho, drilling 15 minutes in hard granite, Kinsella and Leaf, from the Tamarack & Custer mine, won first money, $350, by putting the steel down $34^{11}/_{16}$ in.; Rossman and Haff, with 33⅞ in. to their credit, took second money; while St. Germain and Morrison, the Osburn drillers, were third with $33^{3}/_{16}$ in. Stokes brothers, of Moon Creek, drilled $32^{3}/_{16}$ in.

At Goldfield, Nevada, drilling in a block of granite from Rockland, California, Collins and Lindquist won first money, $500, by drilling 40¾ in.; Hughes and Jelik were second, $39^{7}/_{16}$ in.; Schram and Olson third, 38⅜ in. Single handed, Lindquist drilled 23⅞ in., winning $252; Brooks was second, with $19^{5}/_{16}$ in., and Malli was third, with $18^{9}/_{16}$ in. to his credit.

A HERO WITHOUT A GUN

King George has awarded the Edward Medal of the Second Class to James Wagenaar for bravery in saving life in the City Deep Gold Mine, Witwatersrand, South Africa on October 29, 1913. Wagenaar was working in the mine when he was informed by a native that five other natives down a winze, or steep

incline, had been overcome by the fumes from explosives used in blasting (the debris brought down had interfered with the ventilation and prevented the dispersion of the gas). Wagenaar, tying a wet cloth round his mouth, immediately descended the winze to the place where the natives were lying in various stages of collapse, and, without assistance, brought out four of them in succession. He proceeded down the winze for the fifth time to bring out the last native, but was unable to carry him up more than a few yards, as he was fast being overcome by the fumes, and had himself to be helped out of the winze. Three men, who subsequently brought out the fifth native, also collapsed from the effects of the gas.

THE PROPHET BUSINESS

"What's this new dope they've got for knocking the mining game?" demanded the Pessimist.

"There isn't any new dope," returned Colonel Tepetate only half interested. "Even in Solomon's day, there was no use looking for anything new."

"I mean this stuff about ore and depth."

"That's all right. Did you ever hear of a mine that didn't peter out sooner or later?"

"Of course not. But what is the use of digging up that now, when things are gloomy enough already. Why call attention now to the fact that ore comes only in bunches, with the best and biggest end of the vein near the surface?"

"No use that I can see. Human nature, I suppose. When the gloom is particularly thick somebody is sure to think of something to make the shadows still a little deeper. When a man is having a birthday party nobody remarks that life is but a fleeting show and leads but to the grave. They pull that sob stuff on him when he is down on his back wondering whether it will be worth while to stay and meet the doctor's bill. But I can't find anything to weep about in that best ore near the surface business. Think what it would be the other way around. Suppose you had to sink 5,000 feet before it would pay to begin stoping. Besides, there are mines that pay at the depth of a mile. That is deep enough for me. Hoisting stuff a mile straight up is enough of a pull to satisfy anybody."

"But why did they do it?" insisted the Pessimist.

"You mean digging up that old skeleton when there isn't any feast on? I fail to see how that makes much differences. As I said before, human nature is like that. In hard times there is always some prophet snooping around telling the people that there is an end to all fun. In the old days they used to get sore and stone the prophets, and I've an idea that this particular prophet got his share of rocks too. I see that you're a bit sore yourself, and this Jeremiad wasn't aimed at you or me at all."

"It hits everybody in the mining business."

"Not at all! You and I and the most of us are not trying to sell stock on the old howl of 'richer ore lower down.' You and ninety-nine of the other fellows are not breaking your necks to dig down towards China. You are drifting sideways all you're worth because you're not extra fond of hoisting. As near as I make out this is about what happened:"

The old man took a look to see that his listener's attention was still with him. "As you know, there never was an ore deposit that made so much money for the stock jobbers as that on the Rand. Somebody got up a theory that the Rand mines were on an old gravel bed, one edge tipped up so that it comes to the surface. Some gravel beds are fairly uniform in values, and the Rand reef seemed to be that. The thing flattens out somewhat as it goes down, and what could be finer than a theory that a uniform bed of gold ore cut under a good stretch of southern Africa and stuck out into the ocean? Did you ever see a prettier layout for organizing companies and selling stock?"

"I see! but how many years would they have to dig before finding out what they had?"

"Under the circumstances nobody kicked on that, and it gave more time for selling stock. The idea that the district which is sending so many millions to London and is helping to make our few dollars look so small, could keep it up practically forever, tickled everybody over there, as you can easily see that it would. Quite the most beautiful and most welcome theory that was ever hatched."

"And this prophet fellow came along and took a crack at that lovely theory! Yes, I can easily believe that there might be several

cheerful optimists willing to shy a pebble at him."

"It was rather cruel of him," ruminated the old man, always willing to look at the other side of a thing. "I can't think that he hurt it very much. It takes more than one prophet to sink a beautiful theory like that. England needs that gold, too. It's a heap easier to believe what you want to believe than something that you hope isn't so. Besides nobody has been down there, a mile or two underground, to see what the deposit looks like."

"So, he may be wrong, after all."

"In general he is right, of course. In particular, quien sabe. I am not in the prophet business."

"There's nothing in it."

"Nothing in what?"

"The prophet business."

"I never yet heard of one who tried to get anything out of it for himself."

"Then why do they do it?"

"They can't help it. A prophet is born that way. He just naturally has got to tell people that they are wrong, that they don't know what they are doing. It's his nature. He always picks out something that happens to be very popular at the time, and the result is that he never has many friends."

"He is a nuisance."

"I am not so sure of that. It is a good thing once in a while to show people how ridiculous they are, and to tip them out their hobbies. To be sure, the world never listens to its prophets. It heaves rock at them. But it may set a few to thinking. Anyway, the world has always had them and, I suppose, always will. The modern prophet has a rather tough time of it. He can't fall back on a miracle, like Daniel and Isaiah used to do."—*Mexican Mining Journal.*

TESTING A REFRIGERATING PLANT WITH AIR

BY A. G. SOLOMON.

Using an ammonia compressor for pumping an air test on a plant is something that should be given considerable attention. It is customary to test the high-pressure side of a plant with 300-lb. air pressure and the evaporating coils and other low-pressure piping with from 100 to 150 lb. Many engineers seem to belittle the danger of using the ammonia machine as an air compressor.

TESTING NEWLY INSTALLED SYSTEM.

First, consider the risks in testing a new plant free from oil and ammonia. The machine is new and has been turned over by hand to ascertain that the clearance is right. Then it is turned over with steam, or with the motor if it happens to be motor-driven. With the steam drive the speed can be as slow as desired, but with the motor drive full speed is quickly reached. During this time the compressor does not draw anything from the evaporating side, as an opening is left so that the air is simply pulled in and forced out. Usually, much oil is put into the compressor to lubricate the valves and piston. Some of this lodges in small pockets in the valve cages and the globe valves in the pipes. After everything is ready the machine is turned into an air compressor and the test is begun. A full stream of water is turned through the water jackets, and often a hose is fastened to the discharge line and water allowed to flow over it to remove some of the heat of compression.

The machine should be stopped and allowed to cool after a discharge temperature of not over 250 deg. F. is reached. A thermometer should be inserted in the discharge line at this time, even if it is not left there for future use. The writer believes it would be a good thing to insist on discharge-temperature readings being taken during the test. The erecting engineer should be instructed as to what is a safe temperature and should keep within that limit. The oil for lubrication of the new compressor should be furnished by the builders, to avoid the danger of using an inferior lubricant or one with a too low flash temperature. This will mean that the thermometers and the oil will be a part of the erecting engineer's equipment. The lubricant used in many refrigerating plants is good as far as the low-temperature test goes, but when it comes to the question of gasifying under high pressure and temperature, that is another story. The danger of gas ignition and the resultant internal explosion is not any greater in the old system than in the new. The result of such explosion may be more serious in the former, owing to the possibility of ammonia being liberated.

SCALE MAY START EXPLOSION.

In one way, the writer thinks, a new system is more liable to explosion than an old

one. The cylinder surface and the moving valves and piston are not worn to a smooth finish, and the friction is therefore greater.

Minute irregularities in these surfaces may easily create friction which may cause a spark that will ignite the gas given up by the oil used for lubrication. In the old compressor this danger is not present.

Another producer of sparks may be the particles of scale in the pipes. However well the piping is cleaned, there is some scale which becomes loosened and may find its way into the cylinder. A small piece of hard scale, getting between the piston and cylinder wall, may cause a spark. Also small particles of scale and grit are sent through the compressor valves and the pipe work at high speed. These may cause sparks.

SOAPY WATER AS LUBRICANT PREVENTS EXPLOSIONS.

There is one positive preventive for such explosions in testing a new plant. Do not use oil for lubrication. Use soap and water or some other material which will not give up a gas when subjected to heat. The amount of moisture thus introduced into the system will do no harm, as nearly all of it will be caught by the oil separator in the discharge line.

The proper way, and a way the writer believes should be insisted on, is the use of a special air pump for testing both new and old systems. Such an apparatus can be made to deliver air at a low temperature, and thus do away with the danger of explosion.

Where it is necessary to use a motor-driven ammonia compressor for pumping the air test, it should be stopped often and allowed to cool. This is annoying and takes a little more time, but it is safe. An hour or two more or less will not make any difference to the plant, whereas the bursting of a cylinder, receiver, valve or pipe work may delay the starting of the plant a week or more.

FUMIGATION ABANDONED IN NEW YORK

After a year of testing the efficacy of fumigation in cases of contagious diseases the board of health has announced that the practice of fumigation in infectious diseases in Brooklyn will be immediately discontinued. That means that fumigation has given place to more advanced methods in all the boroughs. In December, 1914, the practice was discontinued in Mannhattan, the Bronx Queens and Richmond, but to satisfy critics and for the purposes of comparison it was continued in Brooklyn. Now Dr. Goldwater has ordered fumigation discontinued altogether. During the period when the health authorities were debating the efficacy of fumigation many experiments were made. The health department calls attention to other and more efficient methods of preventing the spread of disease, that is, cleaning, fresh air, and sunlight, and particularly the renovation of premises by repainting and repapering. Dr. Goldwater said that statistics gathered by the department show that the discontinuance of fumigation is justified. These show that there has been no increase in the prevalence of the various diseases and that better and more efficient disinfection has been performed.

DIRECTOR OF THE BUREAU OF MINES

President Woodrow Wilson on Aug. 27 named Mr. Vanney H. Manning, acting director of the U. S. Bureau of Mines, as director of the Bureau, vice Dr. J. A. Holmes, deceased. Director Manning is from Holly Springs, Miss., and has been connected with the bureau ever since its establishment. He had been assistant director, and, when Dr. Holmes was compelled to relinquish his duties because of his health, Mr. Manning was made acting director.

NOTES

Ordinary blasting powder is not affected by the cold, but in warm damp weather it is liable to take up moisture and thus lose strength. It is made up largely of nitrate of soda with 10 to 15 per cent sulphur and charcoal, and contains no liquid ingredient. Ordinary handling and shaking in transportation does not affect it. It is the nitrate of soda that attracts the moisture in the air.

Acetylene gas is not poisonous, but, like nitrogen, will not support life. One great advantage of acetylene is that it does not make smoke or soot. The spectrum of acetylene discloses the fact that it is the closest approach to sunlight of any of the illuminants. Up to the present no safety-lamp, using acetylene as a source of illumination, has been devised for gaseous mines, but in non-gaseous coal mines it is safe to say that 70 per cent

of the miners are now carrying acetylene lights.

In sinking a shaft in the Lake Superior district it is asserted that the speed of sinking was increased by 55 per cent by the use of a blasting box. Instead of using a long fuse for each hole, one long fuse was used to ignite the powder in the box and this in turn ignited all the short fuses connecting the holes with the box. This is a good idea of course, but that the speed of shaft sinking could be increased 55 per cent by it is an absurd exaggeration.

A substitute for Pumice Stone has been produced answering all the purposes of the natural stone, which consists of a sort of glass rendered porous by expansion. Its constituents are sandstone and clay, and there are said to be no fewer than 10 different grades of the stone manufactured. There is a hard and a soft kind designed for the leather, felt and wood industries; another kind for stucco workers and sculptors; a soft, finely grained variety for polishing woods and for tin goods; another kind suitable for the treatment of lithographic stones; while other varieties are fitted for various duties.

Gas meters in New York are to be photographed by meter-readers in the future, and the gas company believes by adopting this method it will insure an accuracy which it is hardly possible for the hand, eyes and mind to attain in keeping such records. A device has been invented for photographing the indicators of the gas meters. The readers will be equipped with a small camera and a spool of film, the entire outfit being not unlike the ordinary camera. The camera fits over the indicator in the gas meter and by pressing a button a flood of electric light is thrown on the dials and the exposure is made.

The United States leads the world as an exporter for the first time in its history. Total exports for the fiscal year, ended June 30, 1915, aggregated $2,768,600,000, as against $2,170,100,000 for the United Kingdom. This is an increase of 17 per cent. for the United States and 30 per cent. for the United Kingdom compared with last year. Our exports 20 years ago, in 1895, were $807,500,000, against $1,391,000,000 for the United Kingdom. Exports of manufacturers from this country in 1821 were only $8,000,000, but in 1915 they were $1,166,000,000.

A course of instruction and training in sales engineering has been organized by the Ingersoll-Rand Company, 11 Broadway, New York. Qualified and approved graduates of engineering schools, in classes of fifteen or twenty, are distributed and passed along through the factories of the company, when they become familiar with the processes of manufacture, the details of design, construction and operation of the various apparatus manufactured, the assembling, testing, record keeping, etc., and during the course attending also lectures and specific instruction given by the engineers, experts and sales managers of the company.

The steamship "Pennsylvanian," of the American-Hawaiian line, recently set a new record for time of transit from Philadelphia to San Francisco via the Panama canal, making the voyage in 14 days 17 hrs. 25 min. The distance is 5,130 nautical miles, making an average speed of about 348 miles a day. The Canal Record points out that if this vessel had made the voyage by way of the strait of Magellan, a distance of 13,003 miles, at the same speed, the voyage would have required approximately 37 days and 8 hours, or two and one-half times as long as the trip by way of the canal, and that the use of the canal saved about 5,965 bbl. of fuel oil, which would cost $4,772.

Great difficulty has been experienced in the past in landing supplies and mail at the Scotch Cap and Cape Sarichef light stations, Alaska. Owing to the situation of the stations, the condition of the sea is very often unfavorable to making landings through the surf for days at a time. Measures have therefore been taken recently by the Bureau of Lighthouses for the purchase of line-throwing guns for these stations, and for the Cape St. Elias light station, Alaska, now in course of construction. It is believed that these guns will be very useful in landing mail and in connection with landing supplies and transferring the keepers to and from the stations during unfavorable weather.

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

AUGUST 3.

1,148,574. PROCESS OF ISOBAROMETRICALLY FILLING VESSELS AND APPARATUS THEREFOR. ADOLF CASPARE, Rotterdam, Netherlands.

1,148,601-2-3. VACUUM - PRODUCING DEVICE. JAMES MCALEAR, Chicago, Ill.

1,148,706. MILKING-MACHINE. CHARLES SLYVESTER MOORE, Danvers, Mass.

1,148,713. ASSEMBLING - RIG. WILLIAM H. PARRY, Kenosha, Wis.

1,148,738. REGULATOR FOR MIXED-PRESSURE ENGINES. OTTO BANNER, Easton, Pa.

1,148,152. ECONOMY AIR-BRAKE APPARATUS. WILLIAM G. CANION, El Paso, Tex.

1,149,169. VACUUM-CLEANER FOR RUGS. ALONZO D. SEAMAN, Milwaukee, Wis.

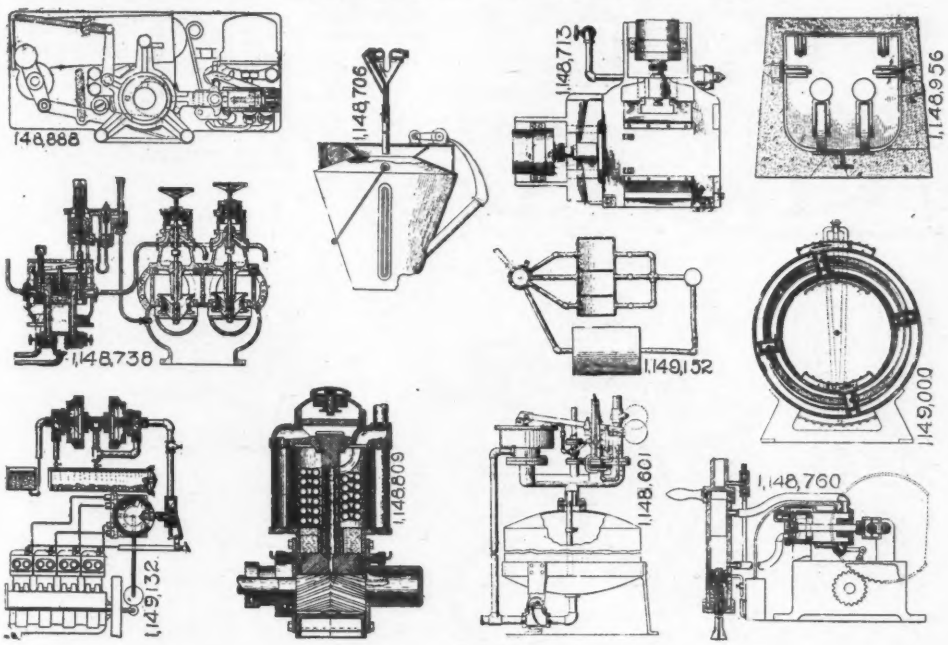
AUGUST 10.

1,149,227. PNEUMATIC SWEEPING DEVICE. EDWARD P. STRODE, Newark, N. J.

1,149,253. CLEANING COTTON DEVICE. EUSTICE E. DICKERSON, Cleburne, Tex.

1. In an apparatus of the character described, in combination with a blower, an air pipe leading therefrom and a boll breaker connected by said pipe with said blower, of means located at the inlet to the boll breaker for increasing the pressure of the air entering said breaker from said pipe, said means being perforated to permit the escape of extraneous matter from the cotton and air prior to their entrance to the boll breaker.

1,149,254. APPARATUS FOR PRODUCING OZONE AND SEPARATING GASES. HORACE DUMARS, Glen Ridge, N. J.



PNEUMATIC PATENTS AUGUST 3.

1,148,760. ROCK-DRILL. CLARENCE A. DAWLEY, Plainfield, N. J.

1,148,809. AIR-COMPRESSOR. MORRIS C. WHITE, Los Angeles, Cal.

1,148,888. PNEUMATIC MOTOR-STARTING APPARATUS. HARRY A. BROOKS, Glendale, Cal.

1,148,956. PNEUMATIC-DESPATCH TUBE AND CARRIER. RODERICK G. COLLINS, JR., New York, N. Y.

1,149,000. ELASTIC-FLUID GENERATOR AND MOTOR MECHANISM. SHERIDAN D. SIMMONS, New York, N. Y.

1,149,132-36. STARTING DEVICE FOR INTERNAL-COMBUSTION ENGINES. HARRY W. HAMILTON, Indianapolis, Ind.

1. In combination, an internal combustion engine, a gas generator which produces gas under pressure sufficient to start the engine and in which the production of gas is controlled by the pressure of such produced gas, and a control valve for admitting gas from said generator to said engine.

1,149,259. VALVE MECHANISM. HIRAM A. HATFIELD, Nogales, Ariz.

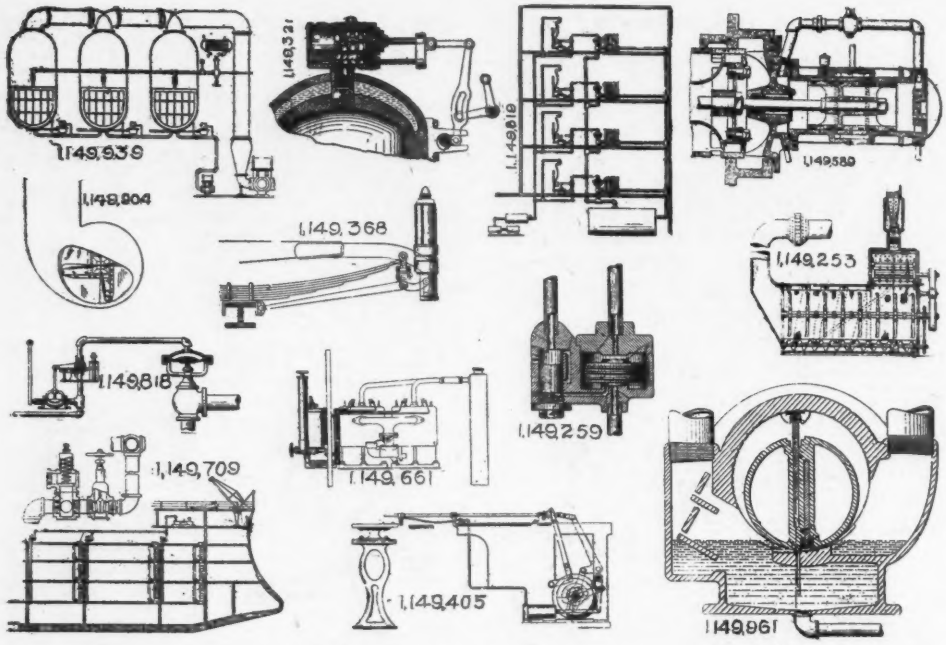
1,149,321-2-3. METHOD OF AND APPARATUS FOR DELIVERING LIQUID FUEL TO OIL-ENGINES. CHARLES WHITING BAKER, Montclair, N. J.

1. The method of operating liquid fuel engines consisting in measuring in separate closed chambers the quantity of liquid fuel required for one working stroke of the engine at full load and the quantity of compressed air required for atomizing it, and drawing from said chambers such a part of their contents as the load on the engine requires.

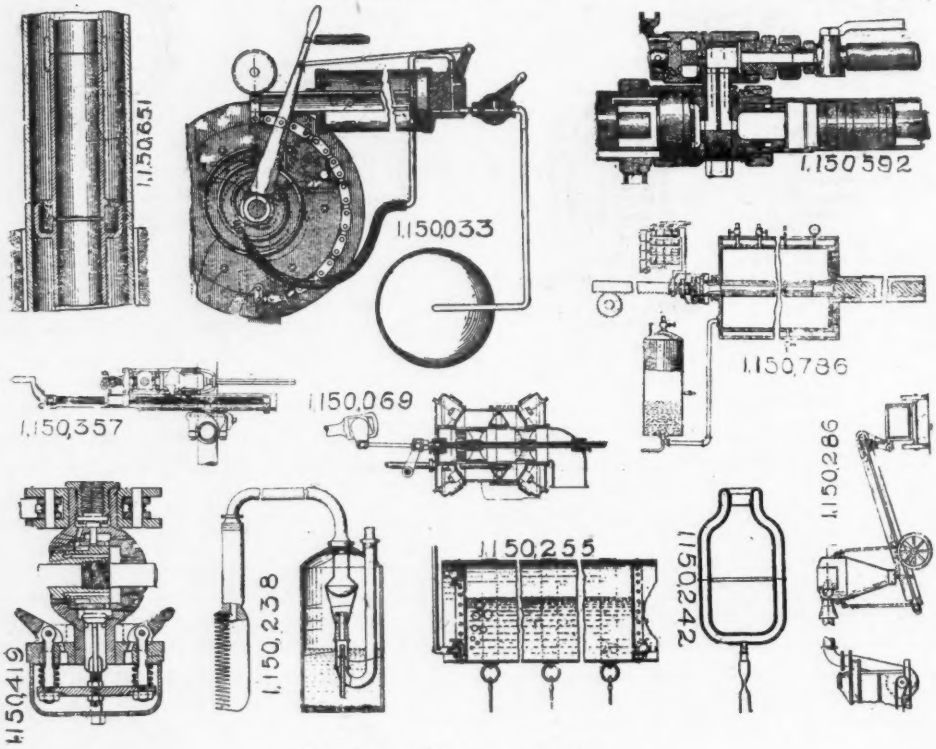
1,149,324. COMPOUND AIR-PUMP. GEORGE W. BALDWIN and PHILIP H. STAPLEY, Bridgeport, Conn.

1,149,363. VEHICLE AIR-SPRING. JONATHAN S. GREEN, Pittsburgh, Pa.

1,149,405. PNEUMATIC DEVICE FOR FEEDING FINISHING-BLANKS TO BOX-COVERING MACHINES. MELVILLE E. PETERS, Denver, Colo.



PNEUMATIC PATENTS AUGUST 10.



PNEUMATIC PATENTS AUGUST 17.

1,149,589. AIR-CUSHIONING MECHANISM. LUTHER D. LOVEKIN, Philadelphia, Pa.

1. In a steam engine, the combination of a reciprocating valve, a cushioning piston attached thereto, a cylinder in which said piston works, a source of pressure fluid, and means for intermittently connecting the two ends of the cylinder to said source as said piston moves through its mid-stroke position.

1,149,638. CENTRIFUGAL FAN AND PUMP. SAMUEL CLELAND DAVIDSON, Belfast, Ireland.

1,149,661. STARTING DEVICE FOR INTERNAL-COMBUSTION ENGINES. THOMAS J. MCCARTHY, New York, N. Y.

1. A vapor starting apparatus for internal combustion engines, comprising a liquid fuel tank, means for placing a body of liquid fuel and a body of air within said tank under pressure, a mixing chamber connected by separate channels with said air and said liquid in the tank, controlling means for causing a jet of air and a jet of liquid flowing through said channels to impact with each other in said chamber, and means for delivering the resulting explosive gaseous mixture directly into the engine cylinders.

1,149,709. AIR-PRESSURE SYSTEM AND METHOD OF OPERATION. WILLIAM WALLACE WOTHERSPOON, New York, N. Y.

1. The method of applying air pressures to ships' compartments to expel water from a leaking compartment and to reinforce said compartment against strains due to internal pressure, which method consists in applying different degrees of air pressure internally to the leaking compartment and surrounding compartments respectively, said pressures being predeterminately selected so that the leaking compartment will receive sufficient pressure to expel water therefrom, and the other compartments will receive a relatively lower pressure to reinforce the walls of the leaking compartment against the strains due to the higher pressure therein.

1,149,818-9. APPARATUS FOR REGULATING TEMPERATURE. JAMES F. GALLAGHER, New York, N. Y.

1,149,904. BLOWER-FAN. JAMES E. FOSTER, Clarksburg, Ontario, Canada.

1,149,939. VACUUM EVAPORATING APPARATUS. EZRA A. NEWHALL, Philadelphia, Pa.

1,149,961. ROTARY VACUUM-MACHINE. WILLIAM E. SHORE, Toronto, Ontario, Canada.

1,149,969-70. BRAKE MECHANISM. SYDNEY E. TAFT, Holliston, Mass.

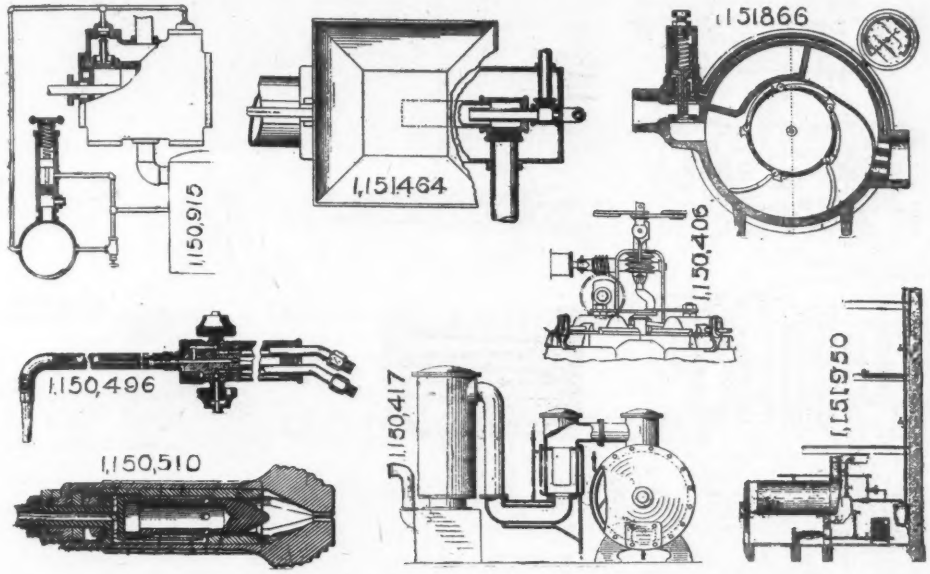
AUGUST 17.

1,150,033. STARTING DEVICE FOR ENGINES. JOHN O. HOBBS, Chicago, Ill.

2. In a starting device for explosive engines, the combination with a shaft, of a crank loosely mounted upon said shaft, means for applying fluid pressure to said crank, a fluid pressure operated clutch for locking said crank to said shaft, means for simultaneously controlling the application of fluid pressure to said crank and clutch and for releasing the fluid pressure from said crank, and automatic means for releasing the fluid pressure from said clutch.

1,150,069. BLOWING-ENGINE AND THE LIKE. CLARENCE N. SCOTT, Buffalo, N. Y.

1,150,238. AERATING DEVICE. DAVE WINBRAY, Hot Springs, Ark.



PNEUMATIC PATENTS AUGUST 24.

1,150,242. METHOD OF PRODUCING A VACUUM IN A METALLIC-WALLED CHAMBER AND SEALING THE SAME. FREDERICK W. BARTLETT, Caldwell, N. J.

1,150,255. VESSEL - RAISING APPLIANCE. HENRY ARTHUR DICKS, Mandeville, La.

1,150,286. CONVEYING AND SEPARATING APPARATUS. FRANK A. MIDDLESTATE, Edison, Wash.

A device of the class described, comprising in combination with a relatively fixed conveying pipe, a frame movable relative thereto, a pneumatic separator provided with an inlet tube and with outlet tubes for the air and separated material, and means for rotatably supporting the said separator on said frame whereby connection may be readily established between said conveying pipe and the inlet tube of said separator.

1,150,357. PNEUMATIC DRILL. GEORGE H. GILMAN, Claremont, N. H.

1,150,419. FLUID-OPERABLE FLUE-CLEANER. PHILIP J. DARLINGTON, Hartford, Conn.

1,150,531. PNEUMATIC DOOR FOR REFRIGERATOR-CARS. SIGFRID A. MILLER, Oakland, Cal.

1,150,592. PRESSURE-FED TOOL. GEORGE H. GILMAN, Claremont, N. H.

1,150,651. AIR-LIFT FOOT-PIECE. NOBEL W. WOOD, Brooklyn, N. Y.

1,150,786. APPARATUS AND METHOD FOR PRODUCING NITRIC ACID. HARRY DALTON RANKIN, Pittsburgh, Pa.

1. In an apparatus for producing nitric acid, the combination of a vessel adapted to contain air under compression, a head or disk operatively mounted therein and carrying electric conductors conveying current from a high tension induction coil, means to reciprocate and rotate said head simultaneously, a vessel connected with said first mentioned vessel, in combination with a high tension induction coil.

AUGUST 24.

1,150,866. VOLUMETRIC AIR-METER. OTTO A. KREUTZBERG, Lake Bluff, Ill.

1,151,936. PULSATOR FOR PULSATORY TOOLS. ARTHUR HENRY GIBSON, Easton, Pa.

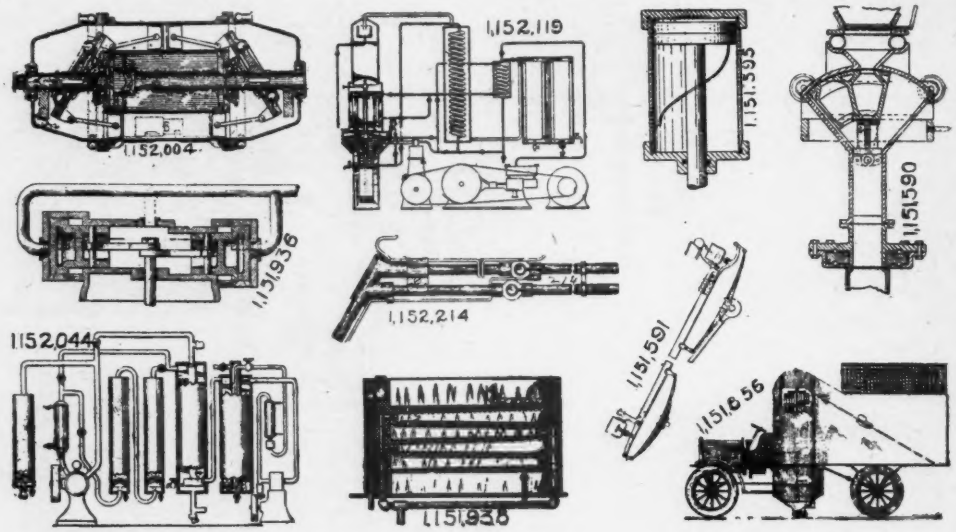
1,151,938. AIR-MOISTENER. ROBERT W. HARDIE, Larchmont, N. Y.

1,152,004. FLUID-PRESSURE MOTOR FOR DRIVING TORPEDOES. GEORGES HENRI MARIUS CANTON, Billancourt, France.

1,152,025. VACUUM-CLEANER. JULIUS KELLER and JOSEPH H. TEMPLIN, Philadelphia, Pa.

1,152,044. ART OR PROCESS OF LIQUEFYING AND SEPARATING AIR. JAMES F. PLACE, Glen Ridge, N. J.

1. The art or process of liquefying atmospheric air consisting of or including the compressing of air substantially to or above its critical pressure, removing the heat of compression and absorbing moisture and carbonic acid gas there-



PNEUMATIC PATENTS AUGUST 31.

1,150,915. UNLOADING SYSTEM FOR AIR-COMPRESSORS. OSCAR R. WIKANDER, Pittsburgh, Pa.

1,150,950. VACUUM CLEANING SYSTEM. FRANK J. MATCHETTE and RICHARD RADDATZ, Milwaukee, Wis.

1,151,406. METER FOR ELASTIC FLUIDS. THOMAS SCOTT, Birmingham, England.

1,151,417. VACUUM-DRIER. FRANCIS J. STOKES, Philadelphia, Pa.

1,151,464. SIPHON-BLOWER. JOHN LAWRENCE HOUSTON, Poughkeepsie, N. Y.

1,151,496. OXO-ACETYLENE WELDING-TORCH. JOHN G. PETTIS, Chicago, Ill.

1,151,510. PERCUSSIVE BOILER-TUBE CLEANER. WILLIAM BURLINGHAM, Newport News, Va.

1,151,540. AUTOMATIC AIR-INTAKE FOR SUBMARINES, &c. ALLEN HOAR, Long Beach, Cal.

AUGUST 31.

1,151,590. GLASS-MATERIAL-HANDLING APPARATUS. HALBERT K. HITCHCOCK, Tarentum, Pa.

1,151,591. PNEUMATIC SPRING. JOSEF HOFFMANN, Mont Pelerin, Switzerland.

1,151,595. EXPANSIBLE CHAMBER. SAMUEL D. INGHAM, Philadelphia, Pa.

1,151,856. VACUUM STREET-CLEANER. PATRICK A. BAYLESS, Oklahoma, Okla.

1,151,859. SECTIONAL AIR-BAG. JAMES P. BROPHY, Birmingham, Ala.

from; and then subjecting the same consecutively, to a succession of increasingly refrigerative actions—1st, to the cooling action of a counter-current of low-pressure expanded air below the normal temperature; 2nd, to the refrigerative effect of a liquefied gas released from pressure and evaporated; 3rd, to the cooling action of a counter-current of the vapor and cold-expanding gases evaporated from liquid air of substantially atmospheric pressure; and 4th, to the cooling action direct of said low-pressure evaporating liquid air—thereby liquefying said cooled compressed air while at substantially its critical pressure.

1,152,119-20. ART OR PROCESS OF LIQUEFYING AND SEPARATING MIXED GASES. JAMES F. PLACE, Glen Ridge, N. Y.

1. The art or process of liquefying and separating a gaseous mixture, which comprises compressing and cooling the mixed gas; delivering one portion of said compressed mixed gas to a liquefier, and another portion to an expansion engine, and expanding the same therein against external resistance; and then liquefying the gas in the liquefier while under compression by the combined refrigerative effect of the cold expanded gas exhausted from the engine, and liquefied gas previously liquefied in said liquefier but released from pressure—both said released liquefied gas and said cold expanded gas being conducted over said liquefier so as to absorb heat from but not in direct contact with the compressed gases being liquefied therein.

1,152,214. BLOW-TORCH. ROSS M. G. PHILLIPS, West Haven, Conn.

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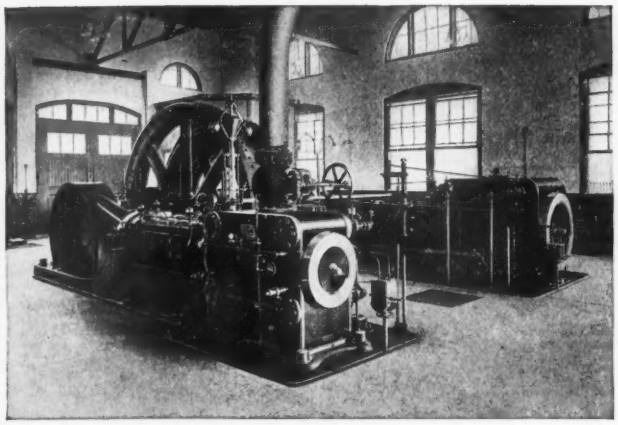

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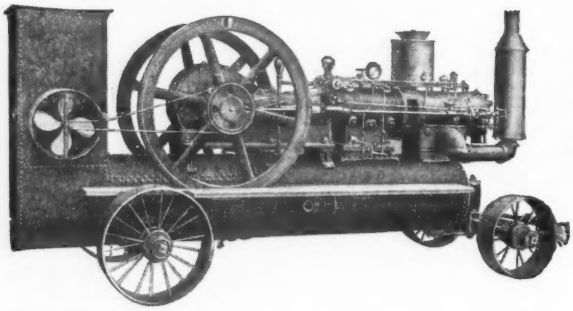

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115	" " " "	18 " "
183	" " " "	25 " "
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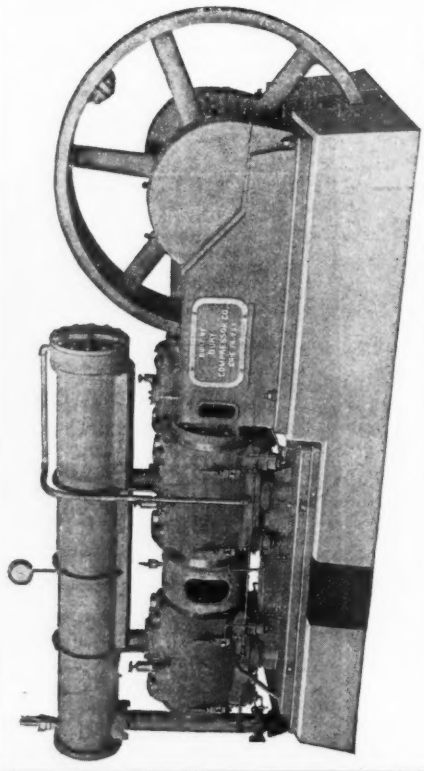

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